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THE FIRST FAUNA OF THE EARTH.

BY JOSEPH F. JAMES, M. D., M. SC., F. G. S. A., ETC.

One of the most interesting questions with which the geologist has to deal is the age of the earth. There is, however, no subject that is wrapped in more profound obscurity, and yet probably none to which more attention has been given. Perhaps it may never be settled positively; but, as years roll on, and more and more facts come to light, speculations may be made with a greater amount of certainty. It may be possible, in the future, to say approximately how many centuries have elapsed since the earth assumed its present form, but, of course, it can be *only* approximate. Estimates vary now between one hundred million and five hundred million years, since the first rocks were laid down.

While this matter still remains uncertain, there is another which was formerly, and still is, in much the same state. It is the beginning of life upon the earth. Geology is a young science, but her sister, Paleontology, is younger. Both are taking rapid strides forward, and, working hand in hand, they will eventually be able to tell us much of interest about this globe of ours.

The steps required to bring any science from a state of chaos to one at all approaching precision are innumerable. The records of these steps are mostly buried in official reports of governmental surveys, technical periodicals, or in the ponderous proceedings of learned societies. It is especially so with geology. To those familiar with these records there is much to excite wonder and surprise. There are romances hidden in them. There are wordy wars and fierce intellectual combats. There are charges and counter-charges. There are victories or defeats, equal in one sense to those of Austerlitz or Waterloo. It needs but the mention of the Darwinian combat to call one of these wars to mind. Another, but more obscure one, relates to the first forms of life upon the earth, and it is the intention here to call attention to this.

It is only a little over one hundred years since the first scientific observations upon stratified rocks and fossils were recorded. It was natural that, in the early part of this century, the crudest ideas should prevail regarding these subjects. The origin and cause of stratification were unknown. The nature of fossils and their value as indices to pre-existing forms of the animal or vegetable kingdom had not been thought of. Some few of the shrewder heads, Rafinesque among them, had begun to see the value of fossils as early as 1818, but the general opinion was probably that expressed by Amos Eaton in that year in the first edition of his "Index to the Geology of the Northern States." Here he announced it as his belief that the land inhabited by the first human beings was supported by two segments of granite, beneath which was an immense sea. The North American Continent, he said, "may now be supported in the same way: and the meeting of the edges of the segments may be near the granitic ridge which extends from Georgia to the Frigid Zone." He further supposed that, during the Deluge, all animals, except those preserved by Noah, were destroyed, and the petrified remains we now find are some of the species overwhelmed by that catastrophe. "Noah," said he, "took into the Ark the land animals of the island or continent whereon he resided. This is now

covered with the ocean, and we know nothing of the remains to be found there." He rightly believed it would have been most interesting to have some account of the researches of the patriarch and his family "among the recent ruins of former grandeur. But we have no account," he says, "of any discoveries nor of any attempts to search out their former inhabitants. It was doubtless well known to Noah that not one foot of the ancient continent remained above water." That Prof. Eaton did not long retain his belief in the theory advanced, seems evident from the fact that these speculations are omitted from the second edition of the "Index," published in 1820. They have since faded from the public mind, and have taken their place with the still older ideas that fossils were fallen stars and Belemnites were solidified thunderbolts.

The rapid advance in public opinion as to the value of geological studies is shown by the organization of numerous State surveys. The first of these was of North Carolina. Prof. Olmstead reported on its geology as early as 1823, and this survey was followed by one in Massachusetts, where Hitchcock reported in 1831. Between that date and 1838, the States of Maine, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Georgia, Tennessee, Kentucky, Ohio, Indiana and Michigan had published reports. The general government, too, had sent expeditions to the northwest, and had published the results. It is true many of the State surveys ceased after the issuance of a few documents, but their existence, even for a short time, was evidence of the belief in their value. Some of the States organized second surveys at a later date, and published numerous volumes. Among these are especially to be mentioned New Jersey, Pennsylvania, Kentucky, Ohio and Indiana. Of all the States mentioned, New York possessed the greatest vitality; and, while there have been changes in it as in others, the work there has been more nearly continuous than in any other. Remarkable as it may seem, the present honored head of the survey, the veteran Prof. James Hall, was one of the original corps in 1837.

Although designed primarily to report upon the general

economic and mineral resources of the respective States, these surveys necessarily became concerned with other work. It was soon found that in order to intelligently describe the rocky strata, it was essential to give the rocks distinct names. These were, at first, taken from mineralogical characters, and such terms as "metalliferous" and "geodiferous limerock" were the result. Or the name was given from some special physical aspect, and then "cliff limestone" and "marlite" were applied. Finally, however, the plan of giving the formations the names of localities where the rocks were either best developed or had been first observed was adopted, and then such names as "Potsdam," "Trenton" and "Niagara" were used.

Another matter, too, which soon became one of the prominent features of the geologists' work, was the study of the organic contents of the rocks. It was early observed that certain species occurred constantly in certain strata, while above or below them, other and different species were found. When once this fact was established, geologists availed themselves of it to place in one horizon, or to consider as of one age, the beds containing the same species of fossils, even when found in distant parts of the country.

The lack of any method of coöperation between the members of the various State surveys, led to great diversity of nomenclature. In New Jersey, Pennsylvania and Virginia, the formations were known by numbers; in Ohio and Indiana they received names from lithological features, while in New York it early became the plan to give the various formations names of places where they were best exposed. Perhaps it is to be considered fortunate for the science that so many of the State surveys ceased early, else the nomenclature might have been as varied as the different States had rocks. It was the vitality or persistence of the New York Survey that enabled her geologists to establish a system of names for almost the whole North American Continent, so far, at least, as the rocks lying within her borders were capable of doing. Thus the "New York System" became a standard to which was referred strata of similar character occurring in all parts of the country.

None of the rocks of New York are of later age than the Devonian. Most of them, indeed, are far older, and so complete is the series that there is no formation from the Archean or metamorphic rocks to the latest Devonian lacking. A portion of the scheme, as finally adopted, is as follows:

Upper Silurian	Lower Helderberg
	Onondaga
	Niagara
	Clinton
	Medina
	Oneida
Lower Silurian	Hudson River
	Utica
	Trenton
	Chazy
	Calciferous
	Potsdam
Archean	

All of the formations lying above the Archean are stratified, and contain a greater or lesser number of fossils. Each formation is generally separated from the one above and below by some unconformity, indicating a time during which deposition was not going on. These time breaks are also characterized by changes in the organic forms. In other localities than New York, these breaks in sedimentation and life do not always occur. Sometimes the change in physical features is so gradual that it is impossible to say where one group ends and the next one begins. Fossils, too, pass from one into the other with little or no change. In all such cases there is great difficulty in drawing any line of demarkation, but, in general, it can be readily done.

In the early years of the existence of the New York Survey, Dr. E. Emmons noted the occurrence of a sandstone in the northern part of the State, lying directly upon the metamorphic or igneous rocks. From its proximity to the town of Potsdam, he gave it the name of "Potsdam sandstone." Its position in relation to metamorphic rocks caused it to be considered the oldest formation in the State, and the organic re-

mains found in it were regarded as representing the earliest life on the globe. These remains were scanty, consisting chiefly of a species of *Lingula* as then understood (Fig. 1), and of some

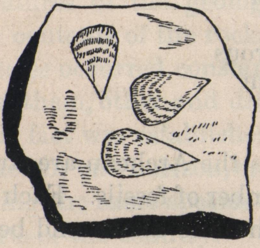

Fig. 1. *Lingula antiqua.* The species for a long time supposed to be the oldest fossil on the globe.

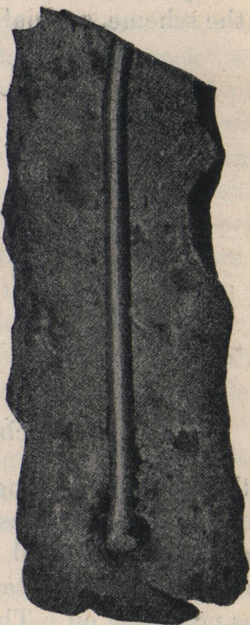

Fig. 2. *Scolithus.* A worm boring.

straight, vertical tubes, at first regarded as seaweeds, but later on as the burrows of marine worms (Fig. 2).

Continuing in western Massachusetts the studies begun in northern New York, Dr. Emmons, in 1842, announced his belief that the Potsdam sandstone was not the oldest, stratified, fossil-bearing rock in North America, but lying beneath it, and therefore older than it, was a great series of sedimentary rocks for which he proposed the name "Taconic." It was not, however, until two years later, in 1844, that he described some fossils from this older series. Among these were two trilobites, and it is probable that more has been written regarding these two fossils than almost any others in the world, and in Figure 3 is shown one of them. These specimens were, of

course, regarded with great interest, as they carried life on the globe further back in time than had ever before been supposed possible. The evidence adduced by Dr. Emmons as to their great age was not, however, accepted by the geological world. Geologists were loath to believe that so highly organized an animal could have existed at so early a period. Some believed the rocks containing the fossils were younger than the Potsdam, instead of being older, considering that even if they were really lying underneath the Potsdam sandstone, that it was by reason of a fault or dislocation which had reversed the original position of the two formations. In fact, the existence of the possibility of a series of *sedimentary* deposits below the Potsdam was denied, although this has long since been admitted. Yet long and bitter has been the controversy over this Taconic system; and while it is now known that Emmons included rocks of various ages in his new terrane, no one disputes the fact that he was the first to record evidence of the existence of animal forms in what are, at present, regarded as the oldest fossil-bearing rocks of the globe.

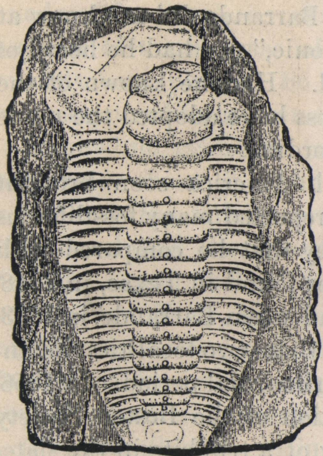

Fig. 3. *Ptychoparia* (*Atops*); *trilineata*. The first trilobite known from the Cambrian rocks.

Previous to Emmons's work in North America, Sedgwick and Murchison had been studying the formations of England and Wales; and in 1835, Sedgwick proposed the name "Cambrian" for a series of rocks in Wales, supposed by him to be without life. A little later, about 1837, Murchison proposed the name "Silurian" for another and a higher series, which he thought contained the earliest forms of animal life. A conflict soon arose between the adherents of the two systems. Murchison extended his Silurian downward as fossils were found at lower and lower horizons, against the vigorous opposition of Sedgwick. It was not until the characters of the

fossils were studied that a definite understanding was reached as to the lower limit of the Silurian. These studies were made by Barrande in Bohemia. He announced, in 1846, his discovery of trilobites with peculiar features. To the fauna, as a whole, he gave the name of "Primordial." He pointed out various differences between it and the English Silurian, calling this last the "Second fauna." Barrande did not know at this time of Emmons's name "Taconic," nor had he heard of the fossils that had been described. Had he known of the work of Emmons, he would doubtless have adopted the name Taconic, instead of proposing Primordial.

Continued investigation in North America soon brought new facts to light. Owen, in 1847, reported many fossiliferous beds in the upper Mississippi Valley that he compared with the Potsdam of New York. Roemer found in Texas, in 1848, fossils similar to those of Owen; and when Barrande, in 1853, heard of and saw the fossils from these two localities, he announced that they belonged to his Primordial period. In 1856, Prof. W. B. Rogers called the attention of the Boston Society of Natural History to the discovery of a trilobite in the slates of Braintree, near Boston. He thought it the same species as that described in 1834 by Dr. Green as *Paradoxides harlani*, and noted, at the same time, the resemblance it bore to a species of the genus from Bohemia, called by Barrande, *P. spinosus*. When he sent a photograph of the new specimen to Barrande, this authority, too, concluded the two specimens were identical. Thus the presence in America of the "primordial" fauna of Barrande was at last firmly established, and the work to come was the filling in of the outlines, closing the gaps and bringing order out of the chaos that had before reigned.

One of the most intricate problems to be settled was that relating to the age of certain rocks in northern Vermont, occurring near the town of Georgia. It was in this region that the fossils described by Emmons had been found. Their age had been variously estimated as Medina, Hudson River and Potsdam (see table of formations on a previous page), but, without going into the details of the controversy, it must suffice to say

that it was at last decided that these "Georgia slates" were older than the Potsdam, but not as old as the Braintree, Mass., beds, in which *Paradoxides* had been found. Prof. Hall had established the genus *Olenellus* to include the Vermont trilobites, and the idea prevailed that this genus succeeded *Paradoxides* in time. It was in 1868 that the first reference was made of the Potsdam rocks to the top of the Primordial period, instead of to the base of the Silurian where they had previously been placed. So that at this time the Braintree beds were supposed to contain the oldest fossils on the globe.

Meanwhile, geologists had been studying the fauna in rocks occurring about St. John, New Brunswick. Noting the resemblance the trilobites there bore to those from Braintree, they concluded the two deposits were of the same age. In Canada, Logan, in 1864, taking cognizance of all the discoveries in New York, Vermont, Massachusetts, New Brunswick and Newfoundland, published a scheme of classification which, for twenty-four years, perpetuated an error. This scheme in its lower portion is as follows:

(3) *Upper Potsdam,* including the rocks of the upper Mississippi Valley, northern New York and adjacent parts of Canada.

(2) *Lower Potsdam,* including the rocks of Georgia, Vermont, and some of Newfoundland.

(1) *St. John Group,* including the rocks at Braintree, Mass., St. John, New Brunswick, and St. John's, Newfoundland.

This view of the succession of the oldest fossil-bearings rocks of North America was held until 1888, except that the three divisions were called respectively, (3) Upper Cambrian, (2) Middle Cambrian, and (1) Lower Cambrian. Of these divisions the Upper was also called the *Dikellocephalus zone,* the Middle the *Olenellus zone,* and the Lower the *Paradoxides zone,* from the three genera of trilobites confined to the rocks of each terrane.

(*To be continued.*)

ORGANIC VARIATION.

BY CHAS. MORRIS.

The recent paper in THE NATURALIST, by Prof. Osborn,[1] on variation in organisms, and the seeming presence of certain unknown factors in development which give rise to phenomena not included in the accepted theories, suggests the desirability of further consideration of this topic. The problem is a most intricate one, the final result being affected by every external condition to which the organism is exposed throughout its whole career, and by various internal influences which are far more difficult to trace, yet are, perhaps, the leading forces at work.

The effects of environment have been abundantly dealt with and are somewhat fully understood. It is not necessary here to state the principles of Lamarckism and Darwinism. It will suffice to say that they do not embrace the whole problem. Darwinism does not attempt to do so, since it takes the great fact of variation for granted and works from that as a basis. Lamarckism attempts to explain variation, as due to use and to the resulting strain upon the organism. But it evidently does not reach the great class of individual variations which are opposed to heredity, and whose cause lies deep in the organism and must be sought in the conditions of the germinal cell itself.

Of the two great underlying principles involved in organic evolution, heredity and variation, the former seems much the most comprehensible. It is but natural to expect that the germ should unfold in the manner of that from which it was derived. Such native tendencies as exist in it must be derived from the parents, and bear a resemblance to those that have been active in the parental organisms. As a result, if parthenogenesis prevailed, we should naturally expect every offspring to repeat all the peculiarities of its parent—all variation being

[1] May, 1895.

due to subsequent influences of the environment. In the case of two parents, the offspring might be expected to possess characteristics of each, now being strictly intermediate, now approaching one parent more nearly than the other. In this method of variation, which is nearly all that Weissmann admits, the steady tendency must be to swamp all distinctions, the differences between parents continually diminishing. In short, these differences could never have arisen were heredity the only force at work. Darwinism has a similar tendency, since varying and ill-adapted organisms tend to disappear, and only those with close similarities of adaptation to be preserved. The changes due to Lamarckian influences must tend also in the direction of uniformity, through a general movement of adaptation to fixed conditions.

Yet this fixed tendency towards uniformitarianism is not what nature displays. Marked individual variations constantly appear, the seeming efforts of nature to produce similar forms being checked at every point by individual peculiarities of constitution. These variations are in opposition to the influences of heredity, natural and sexual selection, use and effort, all of which tend to uniformity. To what are they due? Can a parent transmit to its offspring characteristics which it does not possess itself? This does not seem possible; the natural conclusion being that the offspring should repeat the peculiarities of the parent or parents existing at the period of its birth.

Yet has heredity as overmastering an influence as many ascribe to it? Even if we decline to accept the Weissmann hypothesis, and hold that every portion of the organism, in some way, exerts a direct influence upon the developing germ, it is not impossible that this influence may differ in energy in different organisms, in some cases controlling almost absolutely the constitution of the germ, in others permitting foreign influences, external or internal, to operate to some extent, with consequent variations in germinal constitution.

Several hypotheses have been advanced in explanation of heredity, none of them based sufficiently on discovered facts to be quite satisfactory, and all of them leaving it possible

that the germinal cell may not be rigidly controlled in its development by hereditary influences, but may have a degree of independence and susceptibility to the action of minor and local influences. As variation cannot well be due to influences proceeding from the parental organisms, it certainly seems as if it must arise from conditions existing in the environment of the developing germ and embryo, or to internal molecular forces, left free to produce variations by a degree of weakness in the hereditary influences.

Much certainly depends on the inherent conditions of the reproductive cells. These may vary in developmental energy, through excess or deficiency of nutrition. They may also vary, through position or otherwise, in the quantity of nutriment obtained during development. In consequence, there is probably an active struggle for existence at this low level of life, the numbers involved being considerable, while—in the case of the higher animals—only one or a few can survive. This early competition would seem simply to be one of comparative cell vigor, or of advantage in propinquity to the store of nutriment; but it is, perhaps, not quite so simple. The germinal cell is, to outward appearances, a largely homogeneous organism, but the facts of development prove that it is heterogeneous in constitution, its tendencies and powers being not single but multiple. It probably is made up of various groups of molecules differently arranged or organized, each of which is destined, in its development, to produce a special organ or variety of tissue in the mature form. What we can see very poorly indicates what exists. The compound of organs into which the cell unfolds indicates that conditions preliminary to those organs existed in it, each perhaps located in some definite region of the cell, which may thus be made up of distinct groups of differently organized molecules.

If this, as we have much reason to believe, is the case, the field of competition may be a much more extended one than has been supposed. In addition to competition for nutriment between cells as wholes, there may be an internal competition in each, between its different molecular groups, while differences in original strength may give some of these an advan-

tage over others. Such a difference in original power of absorbing nutriment would, perhaps, grow more declared as development proceeded, and the several molecular groups differentiated into embryo organs.

If such a competition existed, what would be its natural result? Here we have the principle of survival—or, at least, of precedence—of the fittest active within the germ itself, and producing an effect on the constitution of the individual. Certain organs of the embryo might be better supplied with nutriment than others, and, in consequence, become larger or more vitally active in the resulting body. And it may be that this difference in nutrition would have some influence upon heredity; perhaps the weaker, perhaps the stronger, molecular groups being most under control of hereditary influences, and developing accordingly.

If the possibility of such a state of affairs as this be admitted, it may aid to explain the peculiarities of variation. We could understand, for instance, why, in two brothers—even two twin brothers—one is more vigorous in this, one in that, organic function; one has this weakness, one that. Here the heart may be specially strong or weak; here the lungs may be specially active; here the muscular, here the nervous, tissues may be particularly well-developed; here there may be a powerful bodily frame, there a large brain and superior intellect. Similar variations may occur in the digestive and excretory organs, the glandular activity, the deposition of pigment, and other organic conditions. Or one brother may have a general advantage in nutrition over the other, becoming larger and stronger throughout. Differences in the general form of the body, in its fat-making proclivities, in its degree of vital energy, might arise from similar differences in powers of assimilation of the molecular groups of the germinal cell.

The above is offered as a suggestion of a conceivable cause of organic variations. It, unfortunately, belongs to that wide category of hypotheses which are not open to proof. It is not the only suggestion that presents itself. Another influence at work—perhaps a secondary result of that described—is what

is known as atavism. As the influence mentioned is a variation in growth force, atavism seems due to a check in development, the organism not attaining its full unfoldment. Atavism is usually considered as applying to the whole organism, but it may confine its action to certain parts of the organism while the others attain full development, thus producing conditions whose atavistic origin is not evident, and which are accepted as results of ordinary variation.

Two conditions are probably concerned in atavism, one being deficiency of nutriment, the other the influence of environment. In truth, there is good reason to believe that two parallel, and, to a certain extent, mutually exclusive, processes are at work in the organism—those of growth and development. The developmental powers only proceed actively under certain conditions. They differ from growth, which is simply increase of tissue, in being changes of tissue, due to chemical or other influence, and set in train by inherent tendencies in the organism.

There are abundant evidences that energetic nutrition acts as a hindrance to development, and yet is preliminarily necessary to it. The two cannot be active at the same time. While nutrition is active, development is latent, and it cannot set in actively without a marked cessation of nutritive energy. Yet it must be preceded by a period of nutritive activity to provide the tissue within which the developmental forces act, and in which a degree of chemical reduction would seem to precede or accompany the re-organization of tissue into new forms. If the preliminary nutrition be wanting, development may be slight and imperfect, or not appear at all, through lack of the quantity of tissue necessary to the changes in organization.

As regards development, or rearrangement of organic tissue, a question arises as to what influences set it in operation, so that, at fixed intervals, nutrition is checked, growth ceases, and active organic change sets in. Inherent tendencies to such change seem to exist in the tissues, their molecular constitution being such that a series of successive rearrangements take place, reproducing conditions which successively appeared in the phylogenetic evolution of the form, and were gone through

ontogenetically by the parent. Continuous nutrition, and, apparently, also continuous bodily activity, act to check this process of development, which appears to need cessation of the assimilative process and of physical or nervous activity, all the organic powers being concentrated upon the event about to take place.

Nor is this all that may be necessary. Stimulation from without seems often requisite to start the developmental process. Stimulation from within is perhaps equally necessary, a psychic influence it may be, arising in the inherent instincts of the central ganglion of the nervous system. External stimulation may, in some cases, be necessary to set these instincts in action, while in other cases, they may act involuntarily at a certain stage of ganglionic growth or development. It is apparently due to such influences of instinct, that nutrition is checked and the inherent tendencies to changes in the tissues are permitted to act, the action of instinct being thus perhaps secondary; though it may be that a direct stimulation from the ganglion to the tissues is necessary to set the powers of development in operation. The action of the mental powers may, therefore, be confined to checking nutrition and activity, but may also concentrate the physical energies upon the region of coming change, and set in train the necessary chemical action. All the further powers and tendencies requisite exist in the tissues themselves.

We possess abundant evidence that, in the lower animals, development will not proceed if the surrounding conditions be unfavorable, whatever be the inherent tendencies. The life-history of intestinal parasites furnishes marked examples of this. Such creatures may continue a larval existence for an indefinite period in one host, the development to the mature stage being accomplished only after the second host is entered. Possibly, in the first host, nutrition continues active, and is checked on reaching the second host; but the influence of the new environment may have its special stimulating effect. The development of insects present many cases in point. They often continue long in the larval state, in which nutrition is active, growth rapid, and development checked. Then, during

a period of pupal rest and non-nutrition, a rapid development to the mature stage takes place. Adventitious organs, useful to the larva, often develop, and are discarded in the pupal stage, as having no place in the phylogenetic order of development. This is strikingly the case in Echinoderm development, the adventitious organs sometimes forming so large a part of the larval animal that they have the power of swimming and taking food after being discarded, though incapable of digesting it. In this case, the developing portion of the animal is confined to the central life organs. In other instances, the adventitious organs are absorbed and utilized in the process of change.

As an instance of marked retention of the larval conditions, may be mentioned the Aphis, in which no further development takes place through many generations, nutrition being active, and reproduction going on by gemmation. In the autumn, when nutriment begins to fail, the long repressed instincts and developmental powers come into play, and mature insects are produced. The seventeen-year Cicadæ furnish another striking example,they continuing as larvæ during a very long period of underground nutrition, and developing to maturity only when unfolding instinct induces them to seek the surface. Numerous examples of a similar kind may be found in the Hydrozoa, in which development is checked at several larval stages, in each of which a different environment or kind of activity exists.

The ants and bees, among insects, are of high interest in this inquiry. The bees, for example, seem to have worked out the whole problem for themselves, and can produce workers, queens and drones at will. It seems a simple question of nutrition whether queens or workers shall appear, the worker larvæ being underfed, the queen richly fed and with fuller space for growth. They all pass through stages of pupal development, in a state of rest and non-nutrition, but the fully-fed larva becomes a mature female, the illy-fed ones become immature females. During the subsequent life of the latter, no opportunity for complete development occurs, activity and nutrition being incessant. In the ants, somewhat similar conditions exist.

Certain of the Amphibia present marked instances of the influence of environment as a stimulus to development. A tadpole kept forcibly in the water does not become a frog. The Axolotl, a gilled salamander, seems to have a power of choice in this particular. It continues a water breather while it elects to remain in the water, but loses its gills and develops into the lung-breathing Amblystoma if it leaves the water for a land life. Another interesting instance of this appears in the Leptocephali, peculiar larval fishes, small, pellucid and cartilaginous, which are found floating far out in the ocean. Gunther considers them the offspring of various marine fishes which have been swept away from their normal environment and their development in consequence arrested. This is, perhaps, due to deprivation of the requisite nutriment.

Many examples of a check to the full development of the higher animals, through insufficient nutrition, might be given, were it advisable to extend this examination. In the lower animals, so far considered, there would seem to be a competition between two instincts, one the instinct to devour food and move actively, the other the instinct to cease eating and enter a state of rest. External conditions are, perhaps, only influential in giving the precedence to one or the other of these instincts, though, in most animals, the latter instinct in time seems to gain a controlling influence, and development in consequence proceeds.

The instances here given are extreme ones, and are of much value from their bearing upon the question at issue. Doubtless there are many minor steps of development which need no special preparation, and which take place during the ordinary activities of life. Such steps might be pointed out in the invertebrates, while vertebrate development is generally of this character, its stages appearing successively without need of marked cessation from food or activity. Yet the examples adduced are probably exaggerated instances of what always takes place, a period of nutrition of the organ involved, a temporary check to nutrition, a diversion of energy to that organ, and a more or less rapid developmental change. If this change is a considerable one, as in the casting of their shells

by crustaceans, a physical weakening results, and new tissue must be built up before the new shell can appear. A similar weakening is apt to appear in man during the development of puberty, and various other instances might be given.

All this leads back to the question of atavism. The changes indicated may not be solely due to nutrition and stimulation, but may be controlled in a measure by the original germinal conditions, the degree of developmental vigor which exists in each of the molecular groups of the germ cell. If any of these is weakly constituted, or imperfectly organized, its general development may cease before the ultimate phase is reached, or it may be imperfect, and the resulting animal lack some part, as in the absence of a hand or arm. This may be the ordinary cause of the phenomena of atavism, the original weakness of the germ causing a cessation of development before the final stage is reached. This check seems often to occur at the level of some immediate ancestor, but occasionally acts at a considerably more remote stage. Again, weakness in a special region of the germ may check development of some organ at an ancestral stage, while the remainder gains full development. Such a result, while due to atavism, would yield no evidence of it. To this class of influences may be due many of the variations in offspring which so commonly occur.

There is a further possibility to be considered: that of a condition the reverse of atavism. While defects occasionally appear in the mature body, an excess of development also at times appears in certain regions. This may be a duplication, as in the fingers and toes, the development of some limb or organ to a larger size than in the parents, or the appearance of an excrescence which has no paternal counterpart, yet, perhaps, may prove of advantage to the individual. If defects are due, as here suggested, to deficiency of energy of development, or partial formation in some molecular group of the germ, excess may, perhaps, be due to the opposite influence, a superabundance of energy, or excess of molecules in the group. The molecular groups from which the organs, tissues or members of the body are supposed to be derived, may possibly vary, as above-said, both in energy and in formative conditions, and

minute variations in the germ may yield marked variations in the adult.

All this is offered as conjectural. If it be based on fact, some important conclusions follow. To atavism, partial or complete whether due to original germinal weakness or subsequent lack of nutrition, degeneration may be due. The imperfect or poorly developed offspring, if it should prove fitted to some other mode of life than that of its race, might survive and yield descendants like itself. Through such a process, long continued, the extreme degeneration occasionally seen might appear.

On the other hand, if the molecular groups can possess excess of energy or superfluous material, the result may be seen in some unusually large organ or greatly developed tissue, or a general superiority of the whole body; or, again, in the appearance of some duplicate part or excrescence. Such an excess, if advantageous, might, as in the opposite case of degeneration, induce new habits in the animal, and, in time, lead to marked differences in species. If the excess appeared in the nervous system generally, or the brain particularly, an important psychical advance might result. It is certainly not impossible that the extraordinary intellectual powers which occasionally appear in the offspring of parents of ordinary mental development may be due to this cause, and that the gradual advance in mental ability in the animal kingdom, with the superior powers of attack and defence thence arising, have a similar origin.

The problems here dealt with are very obscure ones. In considering them we are, perforce, confined to hypothesis, since facts are beyond our reach, other than such phenomena of organic nature as have been adduced. Certainly the causes of individual variation lie low down in the process of development, and while, perhaps, due in a measure to environmental forces at work on the embryo or larva, are probably due in a much larger measure to conditions connected with the organization and early development of the germinal cell.

ROOT TUBERCLES OF LEGUMINOSAE.

By Erwin F. Smith.

Among those who have contributed to our knowledge of this subject are Beyerinck, Frank, Ward, Hellriegel, Prazmowski, Nobbe, Schlossing, Laurent and Windogradski. The question of the symbiotic relationship of the bacilli, which are certainly present in the tubercles, has received rather more attention from these investigators than have the bacteria themselves. The latter are the subject of an interesting paper, "Die Bakterien in den Wurzelknöllchen der Leguminoseen," by Mr. Gonnermann in *Landw. Jahrb.*, XXIII (1894), Heft., 4, 5, pp. 649–671. The first part of the work was done at the Agr. Exp. Sta. in Rostock, and the rest in the Hygienic Laboratory at Danzig, and the internal evidence of the paper indicates a careful, competent man. The one question which the author at first set out to solve by means of purely bacteriological methods was, What bacterium causes the tubercles? Pure cultures were made from the bacteria occurring inside the tubercles and their behavior first studied on ordinary culture media—gelatine, agar, potato, bouillon, etc. Subsequently, lupine gelatine was used, and proved very suitable, the germs growing in it about equally well, whether slightly acid, slightly alkaline or neutral. The colonies which appeared on this gelatine were then inoculated into various media, from the plates to stick cultures, from these to potato, from the latter to agar, from agar into hanging drops, from these to plates once more, and so on, to insure purity and absolute certainty of the final results. To obtain material for making infections, uninjured tubercles were washed in ordinary water and the earth rubbed away with a tooth-brush, then washed several times in distilled water, and finally put for several minutes into 1-500 solution mercuric chloride. They were then thoroughly washed 3–4 times with sterile water, placed under a bell-jar on a glass plate previously heated to 150° C., cut open with a

flamed knife, and crushed out in a little sterile water, which was then used for cover glass preparations and for the inoculation of culture media. All staining fluids and all culture media were examined for the presence of germs before they were used, and before commencing this investigation the author made a preliminary one of the air of his laboratory to determine what germs were present and might be expected to appear in some of the cultures. The microscope used was a Leitz, which was provided with apochromatic lenses, giving a very clear, sharp field, up even to 2,250 diameters. The root sections were made in the Pathological-anatomical Institute of Dr. Thierfelder, and mostly by Dr. Thierfelder, himself. Several hundred plants were investigated, including *Pisum sativum, Lupinus angustifolius, albus, luteus, Lathyrus tuberosus, Vicia faba, cracca, Phaseolus vulgaris* and *Trifolium incarnatum,* and more than 300 permanent preparations were made. The investigations finally covered the following subjects: (a) Pure cultures; (b) Search for the organisms in the soil; (c) Germination of sterilized seeds in sterile sand and subsequent infection of the plants. Cover-glass preparations, made from great numbers of cleaned, sterilized tubercles of *Lupinus albus* and *angustifolius* showed the well-known Y-shaped bodies and gelatine plate cultures gave two sorts of colonies, both bacilli. Cleaned and superficially sterilized roots were then wrapped in freshly sterilized cotton, put in turn into sterile netting, and finally covered by a fine-meshed sterile wire netting, buried in sterile sand and watered with sterile water. After eight days the plants were pulled up. Many of the tubercles were ruptured and the enveloping cotton was stained brown and swarming with pure growths of the bacteria. The sand was also contaminated. From this infected cotton, and also frequently from the sand, cultures were made into gelatine, bouillon, etc., and from these, plate cultures. The author cannot agree with Frank that the Y-form consists of broken down mycoplasma, for, upon being placed in hanging drops, these Y's break up into motile bacilli and their compound nature can also be demonstrated by proper staining. Beyerinck, Prazmowski and Frank speak of one organism designated

variously as *Bacillus radicicola*, *Bacterium radicicola*, and *Rhizobium leguminosarum*. Gonnermann thinks that there are several germs capable of causing these galls. He calls his organisms *Bacillus tuberigenus*, 1, 2, 3, etc., having isolated no no less than seven varieties, not including two *micrococci*. All of these are characterized, but not as fully as the present state of bacteriology requires. Beyerinck's *B. radicicola* was not found. Soil examinations were begun at Rostock. Earth was scattered on gelatine plates, and soil from lupine fields was washed with sterile water and cultures made from this. By these methods four of the kinds already isolated from the tubercles made their appearance and were cultivated out and their identity established. The most abundant organism in the Rostock fields was *Bacillus fluorescens non liquefaciens*, then followed *B. tuberigenus*, No. 3. This is a motile organism, 0.3 by 0.6μ, united in 2's or more, bright red-brown on potato, yellow-brown or brownish and fine granular on gelatine plates, and able to liquify gelatine rapidly. Winter examinations of earth were made for spores. In soil taken from Rostock, in February, not a living bacterium could be found, but there were numerous spores. This soil was shaken up with sterile water, and the coarsest parts allowed to settle as sediment I. The cloudy fluid was poured off into a sterile test-tube and allowed to settle for a minute to get sediment II. Sediments III and IV were obtained in the same manner, the latter consisting of the finest silt. Cover-glass preparations were made from each sediment and stained with gentian violet for the identification of bacteria, while for spores a corresponding series was dry-heated to 150°C., and then exposed for an hour to boiling carbol fuchsin, washed in alcohol, and afterward, in some cases, faintly stained with methyl blue. Finally, plate cultures were made from each sediment. Sediment I contained numerous bacilli, 4–9, by 0.5–0.6μ, each bearing 2–6 spores. No bacteria free from spores could be found, but plate cultures gave many colonies. No such large bacilli were found in the earth in summer. In sediment II, spore-bearing bacilli were few, but plate cultures yielded many colonies, thus showing the presence of spores. In sediment III, dead Y-forms first

appeared. These stained faintly with ordinary reagents, but distinct round bodies appeared in their interior when they were subjected to the spore stain. In sediment IV, no bacilli were found, but there were small stained bodies which might well be spores, and plate cultures gave numerous colonies. The plate cultures from these sediments yielded unquestionable *B. tuberigenus* 1, 2, 3. The remaining forms appeared to be ordinary soil bacteria, and were not followed further.

From the results of these cultures and the examination of a great many cover glass preparations, the author thinks it is established that the tubercle organisms pass the winter in the earth in the form of spores. Sand cultures and infections were made at Rostock and again at Danzig, the following method being employed. The sand was spread out in an oven and heated for five hours at 150° C. It was then put into 3-litre pots, previously washed many times in boiling distilled water, then several times in 1-500 solution of mercuric chloride, and finally in sterile water. The pots were then covered tightly with sterile cotton and set aside. Subsequently they were infected with organisms directly from the tubercles and also with pure cultures of the same. In the Rostock experiments the pots were watered with Frank's salt mixture and in the others they received only sterile water, bacteria being added from time to time to each watering fluid. The seeds planted in these pots were first soaked ten minutes in 1-500 sol. mercuric chloride and then washed thoroughly in sterile water. The plants grew slowly, but on the whole satisfactorily. When they reached a height of 20 cm., one which had been infected directly from a tubercle was pulled and examined. The rest of the plants prospered and no more were pulled until they were in bloom. Close together on the roots of the plant first pulled there were 5 tubercles. On cutting they showed the rose red color, and the Y-forms were clearly visible on microscopic examination. Similar results had been obtained by previous investigators. More important, therefore, is the result of the infections with cultures known to be pure. Plants grown in pots infected with *B. tuberigenus* No. 3 from Rostock and others grown in pots infected with B. tuberigenus No. 5

from near Danzig developed a considerable number of tubercles in which it was very easy to demonstrate the Y-shaped bodies, and from which pure cultures of Nos. 3 and 5 were again obtained. Since these two forms behave differently on culture media, the author insists that it is no longer a question of one tubercle bacillus, but thinks that there are at least two and probably more, the form varying with the locality. Water cultures were carried on along with the sand cultures, using peas and lupines, but with negative results. Some of the roots decayed and none developed tubercles. Hellriegel first advanced the hypothesis (1886) that the bacteria in these tubercles are capable of taking nitrogen from the air and turning it over to the host plant. This striking hypothesis at once came into favor and was accepted as proved by many writers on agricultural topics. Frank, however, in dry material, found no increase whatever of nitrogen when his Rhizobium grew with the plants. His many experiments show that the garden bean (*Phaseolus vulgaris*) which always bears tubercles under natural conditions never becomes any richer in nitrogen than do beans grown in sterile soil and free from tubercles. This certainly looks more like parasitism than symbiosis. Other experiments made by Frank show that lupines and peas can assimilate nitrogen when grown in sterile humus, and free from tubercles and bacteria. Consequently leguminous plants are able to store nitrogen and enrich the soil without the action of bacteria, and it is not settled how the nitrogen is taken up by the plant. Gonnermann reasoned that if the bacilli really assimilate free nitrogen and turn it over to the host plant, then when they are grown in an artificial medium the latter ought finally to become somewhat richer in nitrogen. Following out this idea, very careful experiments were made with potato broth of a known nitrogen content, but although the bacteria grew luxuriantly for 14 days there was absolutely no increase of nitrogen. The cultures were made in 12 150 cc. flasks and every 24 hours the air was changed, being passed through cotton, strong sulphuric acid, and strong potash liquor to free it from dust, microörganisms, ammonia and carbon dioxide. The analyses were made by Dr. Meyer of the Rostock Agricul-

tural Experiment Station. Experiments by the author confirm Hellriegel's view that the tubercle bacilli are not capable of changing ammonium salts into nitrate, and the evidence is very good that these organisms are not the same as the nitrifying ferments of Windogradski. The Y-form occurs sparingly outside of the tubercles in various parts of the plant. The author also isolated *B. tuberigenus* from tubercles found on the roots of the rape plant. His general conclusions are as follows:

(1). The root tubercles of the Leguminosae are not caused by a single specific bacterium but rather by several, one in one locality, another in another locality.

(2). The Y-forms are zoogloea (Gebildkomplexe) which arise in the plant during the symbiotic or parasitic relations, and later when the tubercles rupture, they break up into the individual bacteria. These pass into the soil, form spores, and in the spring, as bacilli, once more enter the plant to again become Y-complexes during its growth.

(3). The symbiotic relations are not yet known with certainty, for *of themselves* the tubercle bacteria of the Leguminosae are not capable of rendering free nitrogen useful to the plant; much rather is the plant in condition *of its ownself* to take up and use elementary nitrogen without fungous symbiosis. The bacteria aid the plant in doing this and may contribute in part to a higher nitrogen content. Finally, it appears to be established that in spite of the presence of the bacteria the plants do not take up any excess of nitrogen. From the many sided experiments which have been made, it follows also that not merely symbiotic *but also parasitic influences* are at work, and that the function of the bacteria as well as the method of assimilation of free nitrogen is not yet known with any certainty.

DEVIATION IN DEVELOPMENT DUE TO THE USE OF UNRIPE SEEDS.

BY J. C. ARTHUR.

(*Continued from page 815.*)

Such deviations as have been mentioned are readily seen, and are more or less to be anticipated. But what shall we say about the final recovery of such plants? Even if plants are feeble while young, will they not eventually become firmly established and outgrow all traces of early weakness? I think we would say *a priori*, that such would doubtless be the case. It looks reasonable; and yet from both experimental and theoretical data it can be shown that rarely, and only by accident, does the entire restoration of the vigor of the plant under such circumstances take place. I am aware that the majority of observers and writers have held the contrary view, and that Cohn in his admirable treatise came to the conclusion that "in general plants raised from unripe seed are not weaker than those from ripe seed." It is undoubtedly true, that as the plants grow, the differences, which were at first readily detected by the eye, largely or quite disappear. Eventually it is necessary to resort to careful weighing and measuring to bring out the actual facts. This does not mean that the differences are slight and immaterial, but only that the eye cannot detect small variations distributed throughout large objects having irregular surfaces, although in the aggregate they may be considerable.

In the experiment with tomato plants from seed taken from green, half-ripe, and fully ripe fruit, already referred to, (manuscript record No. 82), no essential difference could be detected between the plants after they came into bearing. But weighing exposed the fact that the ripe fruit of the plants from green seed averaged ten per cent lighter than those from ripe seed (see table V).

V.—Tomatoes from Ripe and Unripe Seeds.

Experiment conducted by Arthur.

Degree of ripeness.	Number of plants.	Number of ripe fruit.	Total weight of fruit in grams.	Average weight of single fruit in grams.
Fruit green.........	13	1044	18304	17.5
Fruit half ripe.....	5	439	7858	17.9
Fruit fully ripe...	24	1889	36622	19.4

The experiment with wheat, conducted by Nowacki, and already referred to (see table III), shows a larger number of stalks from ripe than from green seed; and although not so tall, the total growth of stalks in length is greater for the plants from ripe than from green seed. Without going into further details, the general principle may be stated, that plants from green seed will, as a rule, attain a smaller development in both vegetative and reproductive parts than those from ripe seed.

It is furthermore to be pointed out in this connection, that not only are all parts of the plant smaller and less vigorous, but that the different organs bear a different reciprocal proportion. We may classify plant organs roughly as reproductive (fruit, seed, etc.) and vegetative (leaf, stem and root.) The use of immature seed increases the reproductive parts at the expense of the vegetative, and thus it comes about, that there is more fruit formed in proportion to the amount of foliage than normal. In an experiment, or rather a series of experiments originated by Goff,[30] and continued by the originator and the writer, in which the changes due to the use of unripe seed have been made more than ordinarily prominent by the cumulative effect of repetition through several generations, it was found by the writer (see table VI) that a tomato plant, selected as representative of the series grown from unripe seed, bore $3\frac{1}{2}$ pounds of fruit to one pound of the vine (leaves, stems and roots taken together), while a plant of the same variety

[30] For history of these experiments, see Bot. Gaz., xii (1887), pp. 41–42; Rep. Wis. Exper. Sta., viii (1891), pp. 152–159.

grown each year under the same conditions, but always from ripe seed gave only 1⅛ pounds of fruit for each pound of the vine. In this case we have an enormous relative increase of fruitage from unripe seed, which in fact was quite apparent to

VI.—TOMATOES FROM RIPE AND UNRIPE SEEDS.

Experiment conducted by Arthur.

Degree of ripeness.	Weight of vine.		Weight of fruit.		Ratio of vine to fruit.
	lb.	*oz.*	*lb.*	*oz.*	
Immature series	2	10	9	2	1 : 3.475 (3½)
Mature series	5	10½	6	9	1 : 1.127 (1⅛)

the casual observer npon looking at the plants of the two series as they grew in the garden, although it required the scales to disclose how surprisingly great the difference really was. With this increased fruitfulness is also associated an increase in the number of fruit, although they are individually smaller, as also are the seeds. It is stated that von Mons,[31] of Belgium, has applied this method of using green seed to the raising of apples, in order to check too vigorous growth and to increase the fruitfulness.

In connection with the increase of the number of fruit borne by a plant, there is also a tendency to increased earliness in ripening the fruit. In the cumulative trials with tomatoes by Goff, which have just been referred to, the strain from green seed ripened from ten days to four weeks earlier in different years, than the corresponding series from ripe seed. In another experiment with tomatoes by Goff,[32] seed saved from fruit of the same variety, in different stages of maturity, described as very green, pale green, tinged red, light red, deeper red, and fully ripe (see table VII), gave an advantage in earliness of nearly three weeks for the plants from the very green seed compared with those from the fully ripe seed, and of two

[31] Williams, E., Rural New-Yorker, 1890, p. 798.

[32] L. c., iii (1884), p. 224.

weeks compared with those from the half ripe seed; and there was also about two-thirds as much gain in the ripening of the first ten fruits upon the same plants respectively. But such marked difference in earliness, or in fact any difference at all, in favor of plants from immature seed does not always occur; and several observers have noted the reverse results.

VII.—Tomatoes from Ripe and Unripe Seeds.

Experiment conducted by Goff.

Degree of ripeness.	Number of seeds.	Vegetated per cent.	First ripe fruit.	First ten ripe fruit.
Very green........	50	2	126 days.	137 days.
Pale green	50	84	143 days.	157 days.
Tinged Red	50	100	140 days.	151 days.
Light red........................	50	96	141 days.	147 days.
Deeper red......................	50	88	141 days.	147 days.
Fully ripe.........................	50	96	146 days.	152 days.

This is not surprising in view of the fact that it is the weaker plants from which the greater earliness in fruiting is expected, and such plants must necessarily be most affected by the conditions of weather, soil and cultivation, and so their uniform development be most interfered with. It was noted by Goodale,[33] in 1885, and since by Goff,[34] that some early market varieties of vegetables indicate that they may have been originated through the use of green seed.

I have now stated the principal deviations from normal development in plants due to the use of immature seed, which I have myself observed, or for which I find authentic recorded data. They may be grouped and briefly summarized as follows: (1.) There is a loss of vigor, shown in the smaller percentage of germinations, the weakness of the seedlings, and the greater number of plants which die before maturity; (2) the full vigor of the plants is never recovered, although they may and usually do, produce an abundant harvest, and one acceptable to the cultivator, in case of economic plants; (3) the re-

[33] Physiological Botany, 1885, p. 460.

[34] Bot. Gazette, xii (1887), p. 41.

productive parts of the plants are increased in proportion to the vegetative parts, resulting in a greater number of fruits and seeds (although individually smaller) and more rapid ripening of them, than in similar plants from mature seed.

In explanation of these changes, and to bring the phenomena into proper relation with other phenomena of plant and animal life, I venture to assert that *the deviation in development, which comes from the use of unripe seed, does not differ in kind from that resulting from any other method of weakening the organism,* and is to be considered as only a special instance of *the effect of checking the uniform normal growth of the individual.*

I have in my possession a large amount of data with which to substantiate this proposition, but it would be tiresome to present it here, and I shall content myself with a bare reference to a few facts, and trust to your being able to further convince yourselves of its correctness by recalling facts from your own researches or observations.

Imperfect seed of any kind germinates poorly and produces weak plants. This is true of seed shriveled because of injury to the parent plant from insects, fungi, drouth, etc., of seed infested with fungus, of seed that is too old, or of seed deprived of part of its nutriment or otherwise seriously mutilated. That weak seedlings from any cause, as a rule, are likely to remain weak and produce a poor crop, I think is a statement that will be generally accepted without elaboration. It is in reference to the third general feature of the deviations due to immature seed that the chief interest rests; an interest that has sprung up very largely in consequence of the numerous experiments by Professor Goff, extending over the last ten years, and now very widely known, more especially his long series of experiments with tomatoes, in which notable results have been obtained, suggestive of wide economic application, but to which I have been able to make but brief reference in this paper.[35]

[35] Goff's work upon unripe tomato seed and resulting strains is recorded as follows:

Rep. N. Y. Exper. Sta., iii (1884) pp. 224–226; iv (1885), pp. 182–183; v (1886), p. 174.

Bot. Gaz. xii (1887), p. 41–42.

Garden and Forest, iii (1890), p. 427; (see also pages 355 and 392). Cited by Hunn, Bull. N. Y. Exper. Sta. No. 30 (1891), p. 478.

Rep. Wis. Exper. Sta. viii (1891), pp. 152–159.

While the use of immature seed brings about greater activity in reproduction, and a tendency to early maturity, the same is also true of plants from very old seed, as has been recognized for a very long time. It is probably best known in reference to melons,[36] which are generally believed to give more and better fruit when the seeds are five to twenty years old,[37] although the plants will be weak. Observations have not, however, been confined to melons, but are recorded for pears, beans, lentils, etc.

The retardation of the germination due to age is well shown by the tests of tomato seeds made by Lovett,[38] in which seeds from 2 to 6 years old showed the first germination in 10 days, 7 years, in 11 days, 8 and 9 years in 12 days 10 and 11 years, in 14 days, and 13 years, in 18 days. It will be observed that the effect of over-maturity is the same as results from immaturity (cf. table III). The similarity of effect is even better shown by a test of red clover seed made by Nobbe[39] in 1874, in which mature and immature seed of the crop of that year was compared with that of the crop of 1870, the trial being made in December, 1874. The germination of the immature seed was slower than that of the mature seed which had been kept four years, while the total number of germinations for both immature and over-mature seed was much decreased by four years' keeping (see table VIII).

It is evident, therefore, that aging as well as immaturity of seed leads to weakness of the seedlings, and a general lowered vitality.

Some of the same characteristics which we have seen in the plants from immature seed may also be observed when plants

[36] "Es ist behaupted worden, dass Melonenkerne nach mehrjähriger Aufbewahrung Pflanzen liefern, welche weit weiniger ♂ Blüthen bringen, als Pflanzen aus frischen Samen ; nach 5 Jahren sollten angeblich gar keine ♂ Blüthen gebildet werden. Verf. säete 1878 Melonensamen von 1876 und von 1870. Von den älteren Samen keimte eine geringere Zahl; die daraus hervorgegangenen Pflanzen waren etwas weniger kräftig." Baillon (Bull. mens. soc. Linn. de Paris, No. 23, 1878) Just's Bot. Jahresb. vi (1878), p. 328.

[37] Fleischer, l. c., p. 17 ; Schulz, quoted by Cohn, Symbola, p. 9.

[38] Rep. N. Y. Exper. Sta., ii (1883), p. 267.

[39] Samenkunde, p. 346.

VIII.—Germination of Ripe, Unripe, and Old Seed of Red Clover.

Experiment conducted by Nobbe.

Degree of ripeness.	Per cent of total germination in 2 days.		Total germination.	
	Soon after gathering.	4 years after gathering.	Soon after gathering.	4 years after gathering.
Immature seed............	63	0	48	6
Mature seed...............	90	24	88	58

grown on good and on poor soil are compared. It has been noticed by tomato growers that more seed is obtained on poor than on rich soil,[40] which accords with the record for immature strains.[41] The difference in fertility of soil need not be especially marked to secure the effect, if other conditions are reasonably uniform, even good soil compared with yet richer soil produces the characteristic results. In some experiments on wheat made by Latta,[42] the yield on good wheat land was one pound of straw to .55 of a pound of grain, but the same land richly fertilized gave one pound of straw to only .48 of a pound of grain (see table IX); that is, the poorer soil brought about a greater development of the reproductive parts of the plants, as compared with the vegetative parts, than did the richer soil, without regard to the mode of fertilization. This phase of the subject might be extended to great length and many statistics given, but it will suffice for illustration to appeal to common observation of the remarkable size of the flowers and seed pods of depauperate weeds and other plants, and on the other hand, the tendency of plants in rich soil to produce foliage shoots rather than fruit.

It has been recognized by zoologists[43] that "checks to nutri-

[40] Allen, Amer. Gard., xi (1890), p. 358.

[41] Goff, Rep. Wis. Exper. Sta., viii (1891), p. 157.

[42] Bull. Ind. Exper. Sta., No. 41 (1892), p. 94.

[43] Geddes and Thompson, Evolution of sex, p. 218.

IX.—Wheat on Poor and Rich Soil.

Experiment conducted by Latta.

Plat unfertilized produced	1 lb. of straw to .56 lbs. of grain.
Plat with { bone black, ammonia, potash, } produced	1 lb. of straw to .45 lbs. of grain.
Plat with { bone black, ammonia, potash, } produced	1 lb. of straw to .47 lbs. of grain.
Plat unfertilized produced	1 lb. of straw to .55 lbs. of grain.
Plat with horse manure produced	1 lb. of straw to .49 lbs. of grain.
Plat with horse manure produced	1 lb. of straw to .51 lbs of grain.
Plat unfertilized produced	1 lb. of straw to .52 lbs. of grain.
Plats unfertilized averaged	1 lb. of straw to .55 lbs. of grain.
Plats fertilized averaged	1 lb. of straw to .48 lbs. of grain.

tion, especially in the form of sudden scarcity, will favor sexual reproduction." I think I may safely enlarge this statement, and say that *any cause which retards uniform progress in the development of an animal or plant favors reproduction.* By this is meant that after such a check occurs the organism will develop the reproductive parts of its structure faster and more fully than the other parts, and in the case of crops the yield of seed will be greater proportionately, than of the leaves and stems.[44]

Enough has doubtless been said to show that the deviations in development, which arise when unripe seeds are used, drop into a general category of changes dependent upon the available energy of the plant and the uniformity of its development. In general, the change is a tendency toward reproduction at the expense of the vegetative parts of the plant.

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[44] I have developed this proposition more fully, and shown its application in another direction, in an article entitled: "A new factor in the improvement of crops." Agric. Sci., vii (1893), pp. 340–345.

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EDITOR'S TABLE.

—THE late meeting of the American Association for the Advancement of Science was an occasion of instruction and pleasure to all concerned. The hospitality of the citizens of the beautiful city of Springfield and the generally delightful weather, contributed much to the comfort of the visitors. The excursions to points less remote than usual, were, on this account, more enjoyable. The leading club of the place gave a unique entertainment, furnished by the talent of the members.

The only regrettable feature was the small attendance, less than four hundred members having been present. As the locality was accessible to the most populous region of the country, this absence of many of our best-known cultivators of science excited comment. Such a considerable number of our best zoologists remained away from the meeting that the section of zoology was reduced to a fragment of what it should had been. A considerable number of the geologists failed to attend most of the sessions of their section.

There are two principal causes for this falling off in the attendance, which has been characteristic of several recent meetings. One of the principal causes is lack of patriotism and public spirit on the part of a good many of the absentee members. The Association affords to the scientific men of the country the opportunity to present their work to the public, and thus to excite its interest. The Association has a missionary service to which no cultivator of science should be insensible. It is not only a stimulant to education to men of all classes, but it offers matter of thought and occupation to the well-to-do, who are sometimes at a loss for occupation for both time and money. And it should appeal to the selfish interests of the cultivators of science as well, for the Association must influence men of means in suggesting directions for the exercise of their liberality.

The other reason for the small attendance of some of the sections is the absorption of interest in special societies which meet immediately before the Association convenes. It is well for the societies to meet at the same time and place as the Association, but they should be careful not to appropriate too much of its vitality. Due consideration of the importance of the Association to science and to the country, should influence them in this matter, and it is to be supposed that the experience of the last few years is all that is necessary to impress this view on the mind of their members with reference to the future.

In order to remove some special inducements to absenteeism which were presented by the Springfield meeting, the Association adopted two important resolutions. First, that meetings should begin on Monday, so that they should not be interrupted by a Sunday; and, second, that excursions should not be undertaken until after the close of the meeting. These arrangements will have an excellent effect in concentrating both the work and the attendance.

—The Zoological Section passed some important resolutions with reference to the proposed bibliographical bureau and its work. It endorsed the plan introduced by Mr. H. H. Field, for the establishment of such a bureau in Switzerland. It is proposed that this bureau shall issue frequent bibliographical records of Zoölogical papers as they appear; and it is hoped that it will do the same for botanical literature. For its support the Association appropriated the sum of $250.00, to be added to the various sums already subscribed in Europe.

Mr. Field offered a resolution that the bureau undertake to fix the date of publication of all printed matter presented to it. This resolution was adopted by the Section. He also proposed that the date of

publication be regarded as the date of distribution. The Section did not concur in this view. Consultation with leading publishing zoologists present, as well as with botanists, disclosed an almost unanimous sentiment in favor of regarding the date of completed printing, as the only available date of publication. Resolutions expressing this opinion were framed and passed Section F unanimously, and copies were sent to Mr. Field for presentation before the British Association at Ipswich, and the Zoological Congress at Leyden, Holland.

—Officialism is becoming more conspicuous among American office holders than was formerly the case. Years ago, our officials were conspicuous for their politeness to the public, and general disposition to forward their interests. More recently many of the customs collectors have distinguished themselves for their extreme interpretations of the provisions of the tariff laws, so as to render themselves obnoxious, and the country absurd. Still more recently the Post-Office Department developed an exaggerated officialism in refusing to transmit various articles over its routes. Naturalists have had especial difficulties in the matter of mailing specimens. Both zoologists and botanists have been met with refusals to allow the sending of their specimens, which have only been withdrawn after tedious negotiations. No sooner is this point gained than some new and superserviceable postmaster raises fresh difficulties, and the same process has to be repeated. The only permanent remedy is the enactment and enforcement of compulsory education laws, so that all our citizens may learn that the prosecution of the natural sciences is beneficial to the public, and that their cultivators are an important part of the community.

—Among the various acts hostile to science which have rendered the present administration notorious, few will excite deeper regret than the suspension of the journal formerly issued by the Agricultural Department under the name of Insect Life. As a record of the discovery in the greatest of all zoological fields, it has no equal in the world, as its value was assured by the ability of its editors, first, Mr. C. V. Riley, and more recently Mr. L. O. Howard. The policy of the present administration, as announced by the present Secretary of Agriculture, to limit the functions of government to those which are most rudimental, warrants the retort, actually made by one of his scientific experts to him, that the Department itself should then be abolished. The first Secretary, the Hon. Jeremiah Rusk, declared that he was placed at the tail of the administration on order to " keep the flies off of it." The present Secretary seems inclined to let the " flies " remain, not only on the administration, but on the entire country.

—In the death of the U. S. Commisioner of Fisheries the Hon. Marshall MacDonald, the country loses a very efficint officer. It is to be expected that an equally competent man shall succed him.

—We must again remind our contributors that the most certain way of getting soparate copies of their papers is to comunicate with the publishers directly; and the most direct method of doing this is to write their wishes on the copy which goes to the printer.

RECENT LITERATURE.

Rambles in Alpine Valleys.[1]—In this little book Mr. Tutt gives the impressions of a naturalist while exploring the valleys on the Italian side of the Mont Blanc range. Especial attention is given to the insect life, and in describing their habits and habitats, many problems are suggested for discussion. These are touched upon lightly, but never slightingly, the object of the author, as stated in his preface, being to explain simply and clearly, without going deeply into scientific technicalities, the scientific bearings of some of the facts that came under his notice during a holiday spent in that region. The book is very pleasantly written and well repays perusal by the lover of nature and of scenery. Among naturalists it appeals especially to entomologists. Five plates gives some idea of the scenery in the valleys visited.

Lead and Zinc Deposits of Missouri.[2]—This report is published in two volumes of nearly 400 pages each, the subject being treated under three heads. Part I is a general discussion of the history, compounds, modes of occurrence, distribution and industry of lead and zinc throughout the world. Part II deals with the lead and zinc in Missouri. Part III is a systematic and detailed description of the important developments and occurrences of lead and zinc ores in the state of Missouri. Accompanying the report are two papers having a bearing upon the subject: A study of the Cherts of Missouri, by E. O.

[1] Rambles in Alpine Valleys. By J. W. Tutt. London, Swan., Sonnenschein & Co., 1895.

[2] Missouri Geological Survey Vols. VI and VII. Report upon the Lead and Zinc Deposits. By Arthur Winslow, assisted by J. D. Robertson. Jefferson City, 1894.

Hovey, and Methods of Analysis pursued in the determination of minute quantities of metals in crystalline and clastic rocks, by James R. Robertson. A third appendix gives a list of the works referred to in the Report.

Forty-one page plates and 250 diagrams, sections, etc. illustrate the text.

Minot's Land-Birds and Game-Birds of New England.[3]—For nearly twenty years this remarkable and interesting book has ranked among the authorities on the subject of which it treats, and in editing this second edition, Mr. Brewster has not attempted a revision in the sense of adding fresh material, or of altering the text except where it seemed necessary in order to use it in connection with more modern works. It is practically reprinted nearly in it original form. The biographies which form the feature of the book were written from the author's personal observation and comprise descriptions of the mature bird, of their nests and eggs, of their habits, and of their notes. Mr. Brewster has placed in foot notes the latest views as to nomenclature, etc. and in a few instances corrects some of the authors's views. The illustrations are wood-cuts in outline, drawn by the author from nature.

Birds of Eastern North America.[4]—In this handy pocket volume Mr. Chapman aims to give the student a work, free from the technicalities that require a glossary for interpretation. He presents the subject in a comprehensive but simple way. Three introductory chapters contain suggestions as to methods of study, and the problems to be investigated by the student of ornithology—how, when and where to find birds—directions for collecting and preserving specimens including nests and eggs. The remaining pages, some 400 in number, contain the analytical keys, and descriptions of the species. The descriptions are very full, comprising the bird's general range, manner of occurrence, comparative numbers, times of migration at several specific points, its nest and eggs, and finally a brief sketch of its haunts, notes and disposition.

The illustrations are varied and include a charming colored frontispiece, several full-page half-tone plates and upward of one hundred and fifty cuts in the text.

[3] The Land-Birds and Game-Birds of New England. By H. D. Minot. Second Edition edited by William Brewster, Boston, 1895. Houghton, Mifflin and Co., Publishers.

[4] Hand-Book of Birds of Eastern North America. By Frank M. Chapman, New York, 1895, D. Appleton & Co., Publishers.

Origins of Inventions.[5]—This volume is an expansion of the principles laid down by Prof. Mason in a paper on the Birth of Invention written in 1891. Briefly stated, the author's views are to this effect. Invention is stimulated by human wants. In its broad sense the terms covers not only things, but languages, institutions, æsthetic arts, philosophies, creeds and cults. Invention is based on change. This change is in both structure and function, and proceeds from simple to complex, and is also always a change from the natural to the artificial. Prof. Mason finds that these changes follow a definite law of evolution which he states at length. In each culture-area of the earth such styles of invention have been elaborated as to confer upon the people thereof their local or tribal traits.

The book is one of the Contemporary Science Series and conforms in appearance with the other volumes of that series.

A Pretty Book on Plants and Insects.[6]—Professor Weed has shown, in this little book, that it is possible to write a popular work which does not contain the usual preponderance of error and false statement. One is sometimes tempted to say that whenever a popular and readable book appears on a scientific subject, it will certainly turn out to be bad so far as the science is concerned, and too often in the end one is justified in making this severe statement. Here, however, we have an attractive book which is very readable—in fact, popular—and yet it is not full of error. Let any one read the succeeding chapters on the glaucous willow, mayflower, spring beauty, purple trillium, Jack-in-the-pulpit, showy orchis, pink lady's-slipper, fringed Polygala, Canada lily and common thistle, and he will have learned much about plant structure and reproduction, as well as much about the habits of insects, especially their manner of visiting flowers in search of honey. In each chapter the plant named is the starting point from which the author leads the reader out on long botanical and entomological rambles, thus very greatly increasing the scope of the book. The beautiful illustrations add much to the value and attractiveness of the work. It should, and doubtless will be, widely read.

—Charles E. Bessey.

[5] The Origins of Inventions. A Study of Industry among Primitive Peoples. By Otis T. Mason. London, 1895. Imported by Charles Scribner's Sons.

[6] Ten New England Blossoms and their Insect Visitors. By Clarence Moore Weed. Houghton, Mifflin & Company, 1895; 142pp.

RECENT BOOKS AND PAMPHLETS.

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General Notes.

GEOLOGY AND PALEONTOLOGY.

Faunal Migrations.—An interesting account of the changes in the Mesozoic faunal geography of California is given by James Perrin Smith in a recent number of the Journal of Geology (May and June, 1895). These changes the author attributes to migration and points out that marine currents along continental borders are favorable to migrations. His conclusions, given below, are based on a study of the faunal relations of the various series of sedimentary rocks of California, and the faunal relations which California had with various regions during different periods of geologic history.

From the data in hand, Mr. Smith concludes that at the beginning of the Upper Devonian, some widespread disturbance occurred, opening up connection between the American and Eurasian Seas.

The lower Carboniferous fauna of California was developed directly out of Devonian fauna predecessors with the addition of some Eurasian elements by migration.

The Upper Carboniferous fauna was developed directly out of that of the Lower Carboniferous, but still with intermigration with the Russian and Asiatic regions, so that the California Carboniferous resembles the Eurasian even more than it does that of the eastern United States.

The lower Triassic fauna of the West is entirely foreign, having migrated in from unknown regions, but having reached nearly simultaneously the western part of America, the Salt Range in India, and northern Siberia, but having been cut off from central Europe.

The Middle Trias of the West already begins to show relationships to the Mediterranean province of Europe, showing a connection in that direction, while the similarity to the faunas of the Arctic Trias province is disappearing.

In the Upper Trias the nearest faunal affinities are with the Himalayan and the Mediterranean provinces.

In the Lower and Middle Jura there was no connection with European waters through the Pacific region, but rather through the Atlantic or " Central Mediterranean Sea " of Neumayr, bringing a central European fauna.

Near the beginning of the Upper Jura this connection with European waters was cut off, and one established with those of Siberia and northern Europe, bringing in a Boreal fauna.

This same connection was continued through part of the Lower Cretaceous, giving a boreal fauna to the Knoxville.

Near the beginning of the Gault, connection with the Boreal sea of Russia was cut off, and communication established with southern India and through that country with central and southern Europe, bringing in a warm-water fauna. This connection existed during the greater part of the Cretaceous, but after this time the faunas are confined much more closely to their present ranges, although even to-day many of our living and Tertiary mollusca are found in Japan.

These changes in faunal geography are too widespread and easily correlated over great areas to be charged to mere mountain-making; they must rather be of the nature of continental uplift and subsidence. A study of these changes will throw light on the problem of the extinction of faunas and explain the great poverty of certain beds, in which the conditions for life seem favorable.

The fauna of California has not been a genetic series, but rather a succession of independent faunas, derived by migration from various parts of the earth, complicated by the mixture with the products of local development. Therefore, the student that would intelligently study the genesis and history of this fauna, must not neglect the fossil records of any region, since all may have contributed some elements to this complex assemblage of forms.

A new Geomyid from the Upper Eocene.—A rodent from the Uinta beds (Upper Eocene) of Utah, representing a new genus, is described by Prof. W. B. Scott in the Proceeds. Phila. Acad. 1895, p. 269 under the name *Protoptychus hatcherii*. The skull only is known, including the dentition of the upper jaw, but this proves to be of unusual interest and brings to light some unexpected facts which are thus summarized by the author:

(1). Protoptychus, a new rodent from the Uinta Eocene, is an unexpectedly modernized form, which has already acquired very large mastoid bullae, a rostrum, incisive foramina and posterior nares greatly resembling those of the jumping-mice, and, as in that family, the articulation of the jugal with the lachrymal is retained. The infraorbital foramen is of the murine type. The dentition and the shape and construction of the mastoid and surrounding parts of the cranium most resemble those of the Heteromyidae.

(2). The genus is probably to be regarded as the ancestral type of the Dipodidæ and indicates an American origin for this family, being much more ancient than any known representative of the group in the Old World, which it appears to have reached by a comparatively late migration. Paciculus of the John Day beds is a somewhat aberrant number of the same line.

(3). It is not improbable that the Heteromyidæ were derived from some form related to Protoptychus, though not from that genus itself.

(4). The Geomyidæ are descended from early forms which may best be referred to the Heteromyidæ and in which the tympanics and the mastoids were already greatly inflated. The assumption of subterranean habits of life brought about a reduction in this region of the skull and led to the acquisition of the many peculiarities which characterize the recent pocket-gophers. Pleurolicus and Entoptychus represent stages in this change and are more or less directly ancestral to the modern Geomyidæ. (Proceeds. Phila. Acad., 1895.)

Cenozoic History of the Baltic Sea.—In a preliminary report on the Physical Geography of the Litorina Sea[1] Mr. H. Munthe gives a summary of the present saltness of the Baltic and a report of the present distribution of the Mollusca that concern the Litorina-sea especially; he then discusses the question of the distribution of the Mollusca during the saltest part of the Litorina-time. The report includes also the author's investigations of the diatomaceous flora of the Litorina-sea and its rhizopod- and ostracod-faunas (on which subject but little has been hitherto published) and in this connection he gives briefly the testimony of diatoms in the hydrography of the Litorina-sea.

From the facts presented in the communication the late Cenozoic history of the Baltic can be summed up in the following manner:

A. Younger Glacial Epoch.

(1). *Time of the younger Baltic glacier.*

(2). *Late Glacial time.* The land-subsidence in Scandinavia now reaches its maximum during the Cenozoic period. The Baltic has the character of an ice-sea with *Yoldia arctica* Gray, etc., and is in open connection with the Cattegat across the northern part of South Sweden (Lakes Wettern, Wenern, etc.) and possibly also with the White sea across the Ladoga, etc.

[1] The author defines Litorina-time as that relatively salt phase of the Baltic Sea's postglacial history, which was subsequent to the Ancylus time during which the Baltic was shut off from the ocean and had the character of a fresh-water inland lake.

(1). *Ancylus-time.* Owing to upheaval of land in the South Baltic region and gradually also in adjacent parts towards the north, the Baltic ice-sea got the character of a fresh-water lake. Climate temperate. A transgression of the Ancylus-lake takes place at a later phase—due to upheaval of land in the central and subsidence in the southern portions of the Baltic district. At that phase the lake had its outlet within the Danish archipelago.

(2). *Litorina-time.* In consequence the Baltic by degrees came into open connection with the Cattegat through the Belts and the Sound and finally reached the salter and warmer character shown in the paper. Owing to a later upheaval of land—that has been greater the further one goes towards the central parts of Scandinavia—the saltness decreased more and more and in consequence the more stenohalinic forms retired towards the South Baltic district, and *Limnœas*, etc. immigrated ; the Baltic thus entering into the

(3). *Limnœa-time.* This time seems to come, however, so near the present or *Mya-time* that I hesitate whether it is suitable to maintain the *Limnœa-time* as a particular one. (Bull. Geol. Inst. Univ. Upsala Vol. II, 1894).

Fossil Elephants of Tilloux.—M. Marcellin Boule calls attention to the discovery recently made in the " ballastiere " of Tilloux near the station of Gensac-la-Pallue, of the remains of gigantic elephants, associated with implements of human industry. The most noteworthy among these fossils are two tusks of *Elephas meridionalis*, whose size surpasses all the tusks belonging to the Museum of the Acad. Sci. Paris. But slightly bent, their line of curvature measures 2 m., 85, while that of the Durfort elephant in the Museum measures 1 m., 70, and the modern elephant in the gallery of Zoologie 1 m., 87. M. Boule announces also, finding in the same deposit two molar teeth belonging to the same individual, and the remains of other Proboscidians, such as *Elephas antiquus* and *E. primigenius*, also the molar teeth of Rhinoceros, Hippopotamus, *Cervus e laphus* a Bos, probably the *Bison priscus* figured in the collections of M. Chauvet. We have here then, says M. Boule " a deposit similar to those of certain localities in the north of France, characterized by *Elephas antiquus*, but in which there is found a lingerer (*E. meridionalis*) and a fore-runner (the Mammoth) ; another proof of the continuity of geological and paleontological phenomena."

As to the flint fragments found in the same beds with the animals above mentioned, they are often very fine and reproduce the diverse

forms of Chelles and of Saint-Acheul. M. Boule states that in addition to the usual almond forms, there are discs, scrapers, small carefully made, and even plates skillfully cut, things one would hardly except to find in a deposit of this sort. It is the first time, adds the author, that indisputable objects of human industry have been found contemporary with an elephant of which the species has, heretofore, been characteristic of the Pliocene age. (Revue Scientifique, Août, 1895).

The Latest Connection between the Atlantic and Pacific Oceans.—Before the Geological Section of the American Association for the Advancement of Sciences assembled in Springfield, Dr. J. W. Spencer presented a short abstract of some investigations of no small interest to biologists, under the title of "Geological Canals between the Atlantic and Pacific Oceans." In extending his researches on the great changes of level of land and sea and the evolution of the present continental reliefs, the author carried his explorations to the Tehuantepec Isthmus. In that region he found that late in the Pleistocene period there were shallow straits connecting the Atlantic and Pacific Oceans, in a region now elevated about 1000 feet above sea level. The deeper parts of these straits evidently formed canals, now elevated 800 feet. These discoveries show for the first time the very late Pleistocene connection between the two oceans, and the occurrence of shallow waters which have permitted considerable intermingling of littoral fishes and invertebrates, while excluding from the Gulf of Mexico all deep sea fishes, and thus explaining in part the distribution of modern marine life in the waters adjacent to Central America.

BOTANY.

Notes on Recent Botanical Publications.—In the Contributions from the Gray Herbarium of Harvard University (New Series, No. IX), B. L. Robinson and J. M. Greenman publish papers on (1) The flora of the Galapagos Islands, as shown by the collections of Dr. G. Baur; (2) New and noteworthy plants chiefly from Oaxaca, collected by Messrs. C. G. Pringle, L. C. Smith and E. W. Nelson; (3) A synoptic revision of the genus Lamourouxia; (4) Miscellaneous New Species.—The List of plants obtained on the Peary Auxiliary Expedi-

tion of 1894, collected by Dr. H. E. Wetherel has been published in Bulletin No. 5 of the Geographical Club of Philadelphia. It contains 108 species as follows: flowering plants, 77; fernworts, 5; mosses and liverwort, 6; algæ, 2; fungi, 2; lichens, 16. Twenty-two families of flowering plants were represented as follows: *Gramineæ*, 12; *Caryophyllaceæ*, 10; *Cruciferæ*, 8; *Cyperaceæ*, 6; *Rosaceæ*, *Saxifragraceæ*, *Ericaceæ*, *Scrophulariaceæ*, 5 each; *Compositæ*, 4; *Ranunculaceæ*, *Onagraceæ*, *Polygonaceæ*, *Salicaceæ*, 2 each; *Papaveraceæ*, *Portulacaceæ*, *Diapensiaceæ*, *Plumbaginaceæ*, *Boraginaceæ*, *Betulaceæ*, *Empetaceæ*, *Liliaceæ*, *Juncaceæ*, 1 each.—Recent Contributions from the Herbarium of Columbia College contain papers by Mrs. Elizabeth G. Britton (72) on the Systematic Position of *Physcomitrella patens*, and a couple of hybrid mosses; by John K. Small (73) some new hybrid oaks from the Southern States (*Quercus phellos* × *digitata*, *Q. georgiana* × *nigra*, *Q. catesbœi* × *cinerea*); by George V. Nash (74) notes on some Florida plants (including a number of new species); by N. L. Britton and Anna M. Vail (75) an Enumeration of plants collected by M. E. Penard in Colorado during the summer of 1892; by Albert Schneider (76) the biological status of lichens; by N. L. Britton (77) new or noteworthy North American Phanerogams (including several new species, one being *Ranunculus allegheniensis*, from the Mountains of Virginia and North Carolina).—From the Proceedings of the American Microscopical Society for 1894, we have two valuable papers, viz.: The Aeration of Organs and Tissues in Mikania and other Phanerogams, by W. W. Rowlee, and the Structure of the fruit in the order *Ranunculaceæ*, by K. M. Wiegand. Both are fully illustrated by good plates.—Professor V. M. Spalding's paper on the Traumatropic Curvature of roots (*Annuals of Botany*, Dec., 1894) familiarizes us with a new word, and gives a somewhat different explanation to root motions than that made by Mr. Darwin.—In the contributions from the Subtropical Laboratory of the Division of Vegetable Pathology of the U. S. Department of Agriculture (pub. in Report of Mo. Bob. Garden, Vol. 6) Herbert J. Webber gives the results of his studies on the dissemination and leaf reflexion of *Yucca aloifolia* and other species. Some interesting adaptations are shown by the author The leaf reflexion is shown to be a protective device against climbing animals which would be tempted by the succulent fruits.—"American Nomenclature" is the title of a long article by the editor of the *Journal of Botany* (London) in the July issue. The most remarkable part of the paper is that quoted anonymously from an American letter, in which occur some astonishing statements, e. g. "We are now in a very

critical position in this country." "I do not know what the result will be." "You have no conception of the violence of the discussions on nomenclature now going on in this country." It is not conceivable that any reputable botanist would write thus of his fellow workers, and the editor of the *Journal* must have been imposed upon by some petty writer.—CHARLES E. BESSEY.

Fertilization of the Yellow Adder's-Tongue (*Erythronium americanum*).—The common Dog-Tooth Violet or Adder's-Tongue differs remarkably from its nearest ally, the tulip, in its method of fertilization. The blossoms of the latter being deficient in nectar in this country, are visited by small bees for the pollen only. Observations made by me in the spring of 1888 upon the Adder's-Tongue show that small drops of nectar are secreted at the base of the inner petals of the perianth, and that male bees (*Nomada luteola*), together with female bees of the genus *Halictus*, visit the flowers for this nectar, searching the base of the stamens and inner petals to secure it.

W. H. PATTON, Hartford, Conn.

"Aboriginal" Botany.—Mr. F. V. Coville, the Chief of the Division of Botany, and Honorary Curator of the Department of Botany of the U. S. National Museum has issued directions for collecting specimens and information illustrating the aboriginal uses of plants. Information of this kind is so important that it is desirable that more attention should be given to obtaining it by all who have the opportunity. It is suggested that the following points should be kept in mind. (1) Specimens of the plants or parts of plants used for any purpose by the Indians should be secured in such condition as to be readily identified by botanists, and accompanied by notes and memoranda. (2) Specimens of all kinds of manufactures from plants are desired by the National Museum. (3) Great care should always be taken to properly, and fully label every specimen of whatever kind, since much of its value depends upon such data as can be given only by the collector. We would urge all who may be able to contribute to our knowledge in the matter to send to the National Museum for a copy of these directions.

New Species of Physalis.—In the July number of the *Torrey Bulletin* Mr. P. A. Rydberg describes four new species and one new variety of *Physalis*, a genus of which he is preparing a monograph. The new species are as follows, viz.: *Physalis subulata*, from Mexico; *P. comata* from Nebraska, Kansas and Texas; *P. versicolor*, from New

Mexico, Arizona and Mexico; *P. versicolor microphylla* from Mexico; *P. macrophysa*, from Arkansas, Kansas, Texas, and doubtfully North Carolina and Ohio.

The Mycetozoa.—These organisms which have generally been regarded as plants, and which are treated in the ordinary botanical works under the name of Slime Moulds have been recently studied more from a biological standpoint by Arthur Lister, the results of which have been brought out by the trustees of the British Museum in the form of a monograph of the group.[1] The work is of such interest to students of this group that we quote the following selections from the introduction since they contain so much of general information regarding these curious organisms.

"Fries gave the name of *Myxogastres* in 1833, to the group of organisms described in this Monograph, placing it among the Gasteromycetous Fungi. In 1836 Wallroth substituted the term *Myxomycetes* (Schleimpilze) for the older name, and this came to be the generally accepted designation. Later investigations showed that the spores, instead of producing a mycelium, as in the case of fungi, gave birth to swarm-cells, which coalesce to form a plasmodium. In consequence of this discovery, which indicated a relationship with the lower forms of animal life, De Bary in 1858 introduced the name *Mycetozoa.* Under this head he still retained the term *Myxomycetes* for the section so named by Wallroth, but linked with them the *Acrasieæ* of Van Tieghem, a small group inhabiting the excrement of animals; in these the spores are said to produce swarm-cells, as in the *Myxomycetes,* which multiply by division but do no coalesce to form a plasmodium. At a certain period, when the fruits are about to be formed, they become attached in branching strings which concentrate to a point, where they are massed together in aggregations of more or less definite shape; the swarm-cells, however, do not lose their individuality. In *Dictyostelium,* a genus of the *Acrasieæ,* a stalk is formed by the arrangement of a number of swarm-cells in vertical rows in the centre of the heap; the surrounding amœboid bodies creep up this stalk and form a globose cluster at the extremity; here each amœboid swarm-cell acquires a spore-wall, and they become a naked aggregation of spores not enclosed by a definite sporangium-wall. Rostafinski followed De Bary in the

[1] *A Monograph of the Mycetozoa,* being a descriptive catalogue of the species in the Herbarium of the British Museum; illustrated with 78 plates and 51 woodcuts by Arthur Lister, F. L. S. London, 1894. 224pp. 8vo.

view that the formation of a plasmodium indicates a wide separation in the natural position of the *Myxomecetes* from the fungi, but he suppressed that name entirely, adopting De Bary's class name *Mycetozoa* in its place; at the same time, he admitted into his Monograph *Dictyostelium*, a genus of the *Acrasieæ*. The reason for his including this genus may be the fact pointed out by De Bary, that Brefeld in first describing the dense aggregations of swarm-cells into the stalked spore-masses of *Dictyostelium*, refers to them as being "plasmodia; that is, products of the coalescence of swarm-cells;" and it was not until after the publication of Rostafinski's Monograph that Van Tieghem in 1880 and Brefeld in 1884 corrected this view. Accepting the *Mycetozoa* as established by Rostafinski, but excluding *Dictyostelium* on the ground of its not forming a true plasmodium, we have a clearly defined group of organisms separated from all others by the following combination of characters. A spore provided with a firm wall produces on germination an amœboid swarm-cell which soon acquires a flagellum. The swarm-cells multiply by division and subsequently coalesce to form a plasmodium which exhibits a rhythmic streaming. The plasmodium gives rise to fruits which consist of supporting structures and spores; in the *Endosporeæ* these have the form of sporangia, each having a wall in which the free spores are developed. A capillitium or system of threads forming a scaffolding among the spores is present in most genera. In the *Exosporeæ* the fruits consist of sporophores bearing numerous spores on their surface.

The affinities of the *Mycetozoa* have been dealt with by de Bary and Zopf in the works before referred to. It had been suggested that they were allied to the fungi through the *Chytrideæ*, which do not always form a mycelium, and in which the entire vegetative body is finally transformed into a many spored sporangium, the vegetative body and spores having the power of amœboid movement for a longer or shorter time. De Bary, however, mentions among other points of difference that the *Chytrideæ* do not form a plasmodium by the coalescence of swarm-cells, "and there is, therefore, no ground for assuming their direct relationship with the *Mycetozoa*."

The position of the *Acrasieæ* in which the swarm-cells exhibit amœboid movements, but do not produce a flagellum, and aggregate without coalesceing into a true plasmodium, has already been referred to. The view held by De Bary that the *Mycetozoa* are more closely associated with the *Protozoa* is supported by a comparison with the pelagic *Protomyxa* of Hæckel, which is stated to develope a plasmodium by the coalescence of swarm-spores, and differs from the *Mycetozoa*

chiefly in the absence of a firm spore membrane; also by comparison with *Bursulla*, which, according to Sorokin, forms a true plasmodium and minute sporangia on horse dung; the spores do not become invested by a firm membrane, and escape from the swollen apex of the sporangium in the form of swarm-cells, without cilia, but capable of amœboid movement. Zopf extends the *Mycetozoa* so as to embrace the *Monadineæ* of Cienkowski, but De Bary maintains that, whatever may be the points of agreement between the *Monadineæ* and the *Mycetozoa* they are not such as to warrant their being classed with the latter division as defined by himself. Lankester accepts the groups as defined by de Bary, and places them in his grade *Gymnomyxa* of *Protozoa;* he suggests their affinity with the *Sporozoa.* The ingestion of bacteria by the swarm-cells appears to strengthen the view that the group is more nearly associated with the lower forms of animal than of vegetable life, and the name of *Mycetozoa* appears to mark its true position in the borderland between the two kingdoms. For a more complete discussion of this subject I must refer to those who have paid special attention to the allied groups.

In preparing this catalogue of the collection of *Mycetozoa* in the British Museum, the arrangement of orders and genera given by Rostafinski in his Monograph has been mainly followed, with such alterations as observations made during recent years have rendered necessary. DeBary made the group the subject of minute and thorough investigation; and Rostafinski, while studying under him at Strassburg, devised a system of classification which is clear and comprehensive, and is now generally accepted.

The division by Rostafinski of the main section *Endosporeæ* into two parts, distinguished by the color of the spores, has been objected to as being artificial and wanting in universal application, but the cases in which species offer difficulty with regard to their position under this scheme are few, and on the whole the organisms range themselves under the separate heads in a remarkably natural manner, while for determining the species the plan is simple and convenient."

Synopsis of the Orders and List of the Genera of the Mycetozoa.

Subclass I.—EXOSPOREÆ. Spores developed outside the sporophores.

Order I.—Ceratiomyxaceæ. Sporophores membranous, branched; spores white, borne singly on filiform stalks arising from the areolated sporophore. Gen. *Ceratiomyxa.*

Subclass II.—ENDOSPOREÆ. Spores developed inside the sporangium.

Cohort I.—AMAUROSPORALES. Spores violet, or violet-brown, except in *Stemonitis* and *Comatricha*, in a few species of which they are pale ferruginous.

Subcohort I.—CALCARINEÆ. Sporangia provided with lime (calcium carbonate).

Order I.—Physaraceæ. Lime in minute innate granules. Gen. *Badhamia, Physarum, Fuligo, Cienkowskia, Physarella, Craterium, Leocarpus, Chondrioderma, Trichamphora, Diachœa.*

Order II.—Didymiaceæ. Lime in crystals. Gen. *Didymium, Spumaria, Lepidoderma.*

Subcohort II.—AMAUROCHÆTINEÆ. Sporangia without lime.

Order I.—Stemonitaceæ. Sporangia simple. Gen. *Stemonitis, Comatricha, Enerthenema, Lamproderma, Clastoderma.*

Order II.—Amaurochætaceæ. Sporangia combined into an æthalium. Gen. *Amaurochœte, Brefeldia.*

Cohort II.—LAMPROSPORALES. Spores variously colored, never violet.

Subcohort I.—ANEMINEÆ. Capillitium wanting, or not forming a system of uniform threads.

Order I.—Heterodermaceæ. Sporangium-wall membranous, beset with microscopic round granules, and (except in *Lindbladia*) forming a net in the upper part. Gen. *Lindbladia, Cribraria, Dictydium.*

Order II.—Liceaceæ. Sporangium-wall cartilaginous; sporangia solitary. Gen. *Licea, Orcadella.*

Order III.—Tubulinaceæ. Sporangium-wall membranous, without granular deposits; sporangia tubular, compacted. Gen. *Tubulina Siphoptychium, Alwisia.*

Order IV.—Reticulariaceæ. Sporangia combined into an æthalium, the sporangium-wall incomplete, perforated or forming a spurious capillitium. Gen. *Dictydiœthalium, Enteridium, Reticularia.*

Subcohort II.—CALONEMINEÆ. Capillitium present, a system of uniform threads.

Order I.—Trichiaceæ. Capillitium consisting of free elaters, or combined into an elastic network with thickenings in the form of spirals or complete rings. Gen. *Trichia, Oligonema, Hemitrichia, Cornuvia.*

Order II.—Arcyriaceæ. Capillitium combined into an elastic network with thickenings in the form of cogs, half rings, spines, or warts (scanty and often reduced to free threads in *Perichœna corticalis*). Gen. *Arcyria, Lachnobolus, Perichœna.*

Order III.—Margaritaceæ. Capillitium not consisting of free elaters, nor combined into an elastic network. Gen. *Margarita, Dianema, Prototrichia.*

Order IV.—Lycogalaceæ. Sporangia forming an æthalium, capillitium consisting of smooth or wrinkled branching colorless tubes. Gen. *Lycogala.*

VEGETABLE PHYSIOLOGY.[1]

Bactericidal Action of Metals.—Under the title, "The effects of various metals on the growth of certain Bacteria," Dr. Meade Bolton, formerly Associate in Bacteriology in Johns Hopkins University, and now bacteriologist to the City Board of Health of Philadelphia, contributes an interesting study to the *International Medical Magazine* for December, 1894. Following up the experiments of Nägeli, Miller and Behring, he has tested the bactericidal effect of various metals The following are some of his conclusions, stated as nearly as possible in his own words. For the most part agar plates were used and bits of metal were put on as soon as the agar was inoculated with the micro-organism and poured. In some cases the metals were absolutely pure, in some cases they were commercial but marked chemically pure, in one set brass foil was used, and a few preliminary experiments were made with impure metals. *Copper.*—In all cases there is around the metal a clear zone, in some cases narrower, in others wider, and then a narrow zone where there is increased growth. This intensified zone does not have as sharply marked borders as with certain other metals. Both the clear zone and the intensified zone vary appreciably in width, even with the same micro-organism. Tests were made with *Staphylococcus pyogenes aureus* and the colon, typhoid, cholera, and anthrax bacilli. *Brass.*—The zones obtained with the different micro-organisms were similar to those obtained with copper. *Silver.*—The results with this metal were somewhat less uniform than with copper and brass. The intensified zone is better marked with silver than with copper or brass, but is also narrower. In some cases with anthrax no clear zone was to be seen, in others there was a wide zone of lessened

[1] This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

growth or a narrow clear zone followed by one in which the colonies were not as thick as on the rest of the plate. *Gold.*—Purified gold, especially if recently glowed, had no inhibitory effect. In those cases where inhibition was noticed (some plates of anthrax) the gold had not been glowed for several weeks. Miller showed that velvet gold has no antiseptic properties but that certain gold preparations used by dentists, e. g., Pack's pellets, Quarter Century gold foil, and Abbey's non-cohesive foil, inhibited the growth for about 5 mm. all around. *Magnesium.*—Tests were made only on *Staphylococcus pyogenes aureus* and the cholera bacillus. With both these organisms there was a clear inhibitory zone, followed by a zone of increased growth, sharply marked off from the clear zone and gradually fading out on the outside. *Zinc.*—Many experiments were made with ordinary scrap zinc, cast into a sheet, but no note was kept of these. There was a clear zone, however, in every case, and there was probably not much difference between the action of this and of pure zinc. With the latter, all the organisms tested gave a broader or narrower clear zone, surrounded by an intensified zone. With *Staphylococcus p. a.* the clear zone averaged 7 mm. With the cholera bacillus there is a wide clear zone about 1.5 centimeters, and the effect of the zinc is seen as far as 3 cm. away from the metal. With other organisms the clear zone is usually 5 mm., or more, broad, followed by a broad intensified zone that is not sharply marked. *Cadmium.*—With this metal the reactions obtained differ quite strikingly, as a rule. The most peculiar zone observed in the whole set of experiments is that obtained with the micro-organism of anthrax and the pure metal cadmium. In this case there is a perfectly clear zone 5 mm. wide, then an intensified zone of 2 mm. breadth, and a second inhibitory zone 1 mm. wide. In some cases this second inhibitory zone is not entirely free from colonies, but it can always be made out very distinctly. *Mercury.*—There is considerable difference in the behavior of different micro-organisms towards mercury. With *Staphylococcus p. a.* there is a clear zone, about 7 mm. around the metal, followed by a slightly intensified zone which in different cases varies in width from 1 to 3 mm. With *Bacillus pyocyaneus* there is a clear zone 4 mm. broad around the metal and outside an intensified zone, sharply marked toward the clear zone and falling off gradually on the outside. With the cholera bacillus there is a clear zone, 2 mm. around the metal, then a very narrow intensified zone that is well marked. With the bacillus of anthrax there is a broad clear zone, 9 mm. around the metal, surrounded by a very slightly intensified zone that is not sharply marked. With the colon bacillus there

is a clear zone often 7 mm. broad, sharply marked on the inside, then an intensified zone gradually shading off on the outside. With the typhoid bacillus the clear zone is much broader, often 1 cm. across, but the peculiarity is the character of the intensified zone. This is about 2 mm. across, more intense on the outside, away from the metal, and in different cases more or less double, i. e., there is a narrow almost clear zone running all around which divides the intensified zone into two zones. *Charcoal.*—No reaction. *Silicon.*—Do. *Aluminum.*—Do. *Niobium.*—Do. *Antimony.*—With *Staphylococcus p. a.* this metal gives a clear sharp zone about 1 cm. wide, then a zone about 5 mm. wide where there is diminished growth. In one of the plates there was only a very narrow clear zone. With the colon bacillus there is a breadth of 8 mm. where the growth of the colonies is somewhat thinner than on the rest of the plate, but no clear zone. The intensified zone is quite distinct and about 1 mm. broad. With the typhoid bacillus there is an almost clear zone of 1 cm., then an intensified zone 2 mm. broad. With the anthrax bacillus there is a perfectly clear zone 1.8 cm., then an indistinct intensified zone. With the cholera bacillus there is no sharply marked clear zone, but diminished growth can be made out as far as 1.5 cm. to 2 cm. around the metal. *Bismuth.*—*Staphylococcus p. a.* with this metal gives a clear zone about 2 mm. wide and an indistinct, narrow, intensified zone. With anthrax cultures there is a clear zone 1 mm. wide. Pyocyaneus, cholera, typhoid and colon bacilli gave no reaction with bismuth. *Iron.*—A bright polished wire nail gave a clear zone about 7 to 10 mm. wide with the typhoid bacillus and with the colon bacillus. Other organisms were not tested. Behring is said to have obtained negative results with iron. *Nickel.*—Pure nickel failed to give any reaction with most of the micro-organisms tested. *Platinum.*—Platinum wire and platinum black failed to give any reaction with any of the micro-organisms tested. From the above results it is notable that it is precisely those metals that are resistent toward chemical reagents in general which fail to show any reaction or do so only to a limited extent. On the other hand, metals that are readily attacked by chemical reagents all exhibit a marked inhibitory action on the growth of the bacteria. The effect is, therefore, probably due to a solution of the metal in the medium, and putting bits of metal on the cultures is really equivalent to the addition of a small amount of that salt of the metal formed by the action of the nutrient medium. Traces of the metal may, moreover, be detected by chemical reagents in the nutrient medium surrounding the metal. The explantion of the clear zones is thus quite

evident, but the explanation of the intensified zones and of the second inhibitory zone, sometimes seen, is not very apparent. It is probable, however, that the dissolved oxides or salts of the metals are in too great concentration in the clear zone, and that the trace present in the intensified zone may stimulate growth. This does not explain the second inhibited zone. The length of time it is necessary to leave the metals in contact with the agar, in order to develop the inhibitory action was tried with brass, copper, cadmium and zinc. Plates of *Staphylococcus p. a.* were made in the usual way and the metals put on and removed at various intervals. With cadmium there was a clear space where the metal had lain and for 1 mm. around, where the metal had been left on for a minute. Where the metal had been left on for 3 or 4 minutes or more the clear space usually extended over 3 mm. around where the metal had lain. With zinc the results are similar as regards length of time, but the edges of the clear zone are not well defined and there is an intensified zone that is not apparent with cadmium. With brass there was no effect produced by leaving the metal on for 36 minutes; after this there was more and more marked inhibition up to 50 minutes, but no clear space except where the metal was on for a longer time than this. With copper no visible effect was produced in less than 36 minutes. After this time there was more and more marked inhibition, but only where the metal had been allowed to lie on for 50 minutes was there a clear space. The whole paper is very suggestive and is commended to experiment station workers and all who have to deal with problems relating to fungicides and germicides. Probably the increased development and prolonged activity of chlorophyll in foliage sprayed with Bordeaux mixture is also attributable to the stimulating effect of the minute traces of copper that must pass into the leaves. The paper contains 10 pages and 11 figures, and has been distributed as a reprint.—Erwin F. Smith.

ZOOLOGY.

Antivenine.—Prof. Fraser has laid before the Royal Society of Edinburg some important results of his admirable experiments on snake poisons and their antidote. His method is to ascertain the minimum lethal dose for an animal, to begin experimenting upon a similar animal with a smaller dose. After a short interval he increases this

dose until, in time, he can inject fifty times the minimum lethal dose into the animal's blood without producing any bad effects. This animal is immunized, and its blood serum, injected into another animal of the same size and weight, will prevent the action of snake poison when injected. This immunized blood serum is called, by its discoverer, *antivenine*.

In experimenting with rabbits it was found that the blood serum of one which had received thirty times the minimum lethal dose was as effective in its antitoxic properties as that of one which had received fifty times the minimum lethal dose.

The antivenine obtained from a horse was found to be twice as powerful as that from the rabbit. In immunizing a horse the same method is adopted as is used for the rabbit, viz.: to begin by injecting a small dose; then to give regularly increasing doses, every few days, until fifteen times the minimum lethal dose is administered. The blood serum from from a horse thus immunized is found to be so powerful an antivenine that a hundredth, and even the thousandth part of a cubic centimeter per kilogramme of animal was sufficient to prevent death from the minimum lethal dose of the venom. For a horse to arrive at this stage of immunism requires four months and a half.

The antivenine can be kept for use in two forms, liquid and dry, of which the latter is preferable as less liable to decomposition.

In the course of his experiments, Prof. Fraser discovered that dietary has an effect upon venom poisoning. If a herbivorous animal be put upon a flesh diet, the effect of venom upon it is lessened.

Through another set of experiments Prof. Fraser concludes that the deadly effects of serpents' venom is due to its action on the blood. Venom is almost inert when introduced into the stomach. Nevertheless, an animal may be immunized by the administration of poison into its stomach. This fact is due to the absorption of the poison by the blood. This may account for the immunity from snake-bites said to be enjoyed by some of the snake-charmers of India, who eat the poison-glands of the snakes.

Snakes themselves have been noticed to be impervious to the effects of the poison. This may probably be due to the absorption of venom shed from poison-glands through the mucous surfaces of the mouth, or by the blood-vessels and lymphatics passing to and from the glands. In some cases it may be secured by serpents devouring other members of their tribe.

It is now within the range of certainty that, at no distant date, Dr. Fraser will be able to have sufficient quantities of antivenine from the

immunized horse to be of practical value to those who are exposed to the bites of venomous snakes. It remains now to discover the chemical constituents of the antivenine, so that it may be manufactured in such quantities as to reduce its cost. (Knowledge, Aug., 1895).

Dall on the Lamellibranchiata.—In his contributions to the Tertiary Fauna of Florida, Part III, Dr. Dall adopts a new classification of the Pelecypoda for which he claims the merit that the groups are comparably defined. The general features of the system proposed by the author in 1889 have been revised, and form the basis of the one now offered. As a matter of convenience, the division Pleoconcha made by Neumayer to contain certain synthetic types is retained for a temporary resting place until more is known of these undifferentiated ancient forms.

For the present, then, the class is divided into the following groups, of which the third represents the most perfected (although not always the most specialized) modern type of Pelecypoda.

Order Prionodesmacea containing 34 families grouped under 10 superfamilies. Order Anomalodesmacea, 15 families under 3 superfamilies. Order Teleodesmacea, 46 families under 18 superfamilies. The Palæoconcha, 11 families.

Under each family is an enumeration of the chief generic groups believed to be referable to it.

The genus Solemya Lamark, in this new classification, is placed with the Prionodesmacea. (Trans. Wagner Free Institute, III, Pt. 3, 1875).

On the Species of Uma and Xantusia.—In The Naturalist for 1894, p. 434, I gave descriptions of the two species of Uma known to me at that time. An examination of the material in the U. S. National Museum has revealed two additional species, which I describe below. The *U. rufopunctata* is based on nine specimens, of which seven are from Arizona, where they were obtained by Dr. E. A. Mearns, U. S. A. The *U. inornata* is represented by a single specimen (No. 16,500), from the Colorado Desert, San Diego Co., Cal., from Mr. C. R. Orcutt.

I. Black crescents on the throat, and a black spot on each side of the belly.

Labial scales strongly keeled, six keeled suborbital scales; eight loreal rows; hind-foot shorter, one-third head and body; femoral pores 40–50; dorsal spots black; *U. scoparia* Cope.

II. Black spots on side of belly, but no crescents on throat.

Labial scales strongly keeled, three or four keeled suborbitals; five or six loreal rows; ten or eleven supraocular rows; hind-foot shorter, one-third head and body; femoral pores 24–28; dorsal spots rufous; *U. rufopunctata* Cope.

Labial scales weakly keeled; nine loreal rows; fourteen supraorbital rows; hind-foot longer, two-fifths head and body; femoral pores nineteen; *U. notata* Baird.

III. No black spots on belly or crescents on throat.

Labial scales strongly keeled; five or six loreal rows; ten or eleven supraocular rows; hind-foot shorter, one-third head and body; femoral pores 19; *U. inornata* Cope.

In the young the disciform areas are imperfectly outlined.

All the species are from the Sonoran region.

In the last number of THE NATURALIST, p. 859, I described a new Xantusia from California, but neglected to give it a name. I propose that it be called *X. picta*.—E. D. COPE.

Comparisons of Marriages and Births in the Different European Countries.—The following facts were compiled by M. Chervin and presented by him to the Anthropological Society at its recent conference at Broca. The first fact to be noted is that in respect to the number of marriages France falls a little below the number recorded in the principal countries of Europe, as the following table testifies.

Of 1000 people of both sexes, over 15 years of age, the per cent. that marry is as follows: Hungary, 91.6; Germany, 53.0: England and Wales, 52.6; Denmark, 52.0; Austria, 51.3; Italy, 50.1; Finland, 49.2; Holland, 49.0; France, 45.8; Belginm, 41.9; Greece, 41.6; Scotland, 40.9; Switzerland, 40.8; Ireland, 23.0.

But the number of marriages is only one of the factors in the problem of the increase of population. The most important thing is the fecundity of these unions. Statistics in regard to births are given as follows: (1) Legitimate living children born of 1000 married women from 15 to 50 years of age—Germany, 270; Scotland, 269; Belgium, 265; Italy, 251; England and Wales, 250; Austria, 250; Sweden, 240; Ireland, 240; Switzerland, 236; France, 163. (2) Illegitimate living children born of 1000 unmarried women from 15 to 50 years of age—Germany, 265; Scotland, 199; Belgium, 198; Italy, 246; England and Wales, 121; Austria, 444; Sweden, 444; Ireland, 41; Switzerland, 102; France, 167.

These lists show that in respect to legitimate births France falls below the other European countries, and even taking into account the

illegitimate births, she is far behind Germany, Austria and Italy in point of increase of population. (Revue Scientifique, May, 1895).

Additions to the Mammal Fauna of British Columbia.—MICROTUS PRINCIPALIS sp. nov. Type, ad. ♂; col. of S. N. Rhoads, No. 2346. Col. by A. C. Brooks on the Mt. Baker Range (alt. 6000 ft.), Westminster Dist., B. Columbia, Aug. 16, 1895.

Description: Size, largest of the western *Microtinæ*, color and proportions as in *M. pennsylvanicus*. Skull broad, rectangular. Incisors strongly produced anteriorly; molars relatively very weak. Incisive foramina short and compressed, not reaching anterior molars by 3 millimeters.

Above, including tail and feet, grayish-brown, not darker along median line. Below, sooty gray, darkest where bases of hairs are exposed, distal two-thirds of hairs dull white; sides of lower neck and lips white. Pelage soft and silky. Fourth loop of $\underline{\text{m. 1}}$ triangular, meeting fifth loop medially, the latter nearly twice as large as former and scroll shaped. The same remarks apply to the last two sections of $\underline{\text{m. 2}}$. Trefoil posterior section of $\underline{\text{m. 3}}$ one and two-thirds length of anterior section of same tooth, this section being composed of an anterior loop and two opposing triangles. The formation of $\overline{\text{m. 1}}$ is as follows: an anterior subcircular loop opening broadly into two angular wings whose lateral points form the anterior pair of a series of five angles on the inner and four on the outer sides of the tooth, including the opposite angles of the posterior loop and the lateral points of two outer and three inner closed triangles.

Measurements: Total length 246 millimeters; tail vertebræ (tip missing), 78+; hind foot, 29.5. Skull: basilar length, 36; length of nasals, 11.6; interorbital constriction, 5.2; zygomatic expansion, 23.2; crown length of molar series, 8 ; length of mandible, 25; greatest breadth of mandible 12.5.

This large Vole need be compared with only one described species, *Microtus macropus* (Merriam) from the mountains of Idaho. The most decided differences which can be noted from Dr. Merriam's description and figure are in the molar dentition as particularized above and which can best be understood by a comparison with the diagnosis and plate II in North American Fauna No. 5. Besides the type, Mr. Brooks sent me a two-thirds grown specimen of this Vole which is very similar in color to type, with softer and shorter pelage. Its tail is unicolor, dark and very thinly haired.

PHENACOMYS ORAMONTIS sp. nov. Type, ad. ♂ ; col. of S. N. Rhoads, No. 2354. Col. by A. C. Brooks on the Mt. Baker Range (alt. 6000 ft.), Westminster Dist., B. Columbia, Aug. 6, 1895.

Description : Above uniform blackish-brown, feet grayish, blackish at instep and wrist, nearly white on digits. Upper tail blackish, lower tail gray, tip white. Lower parts soiled white, showing the plumbeous bases of pelage. Ears smaller, but nearly as prominent, as in an *Evotomys* of same size.

Measurements: Total length, 154 mm.; tail vertebræ, 38; hind foot, 20.5. Skull: basilar length, 23 ; length of nasals, 7.8 ; interorbital constriction, 3.4 ; zygomatic expansion 15.7 ; length of interparietal, 4.1 ; width of same, 6.9 ; length of mandible, 16.3 ; greatest breadth of same, 9.2.

This short-tailed Tree Vole is very different from *P. longicaudus* True, its nearest geographic ally. From *P. intermedius* of south central British Columbia it is distinguished by the exceedingly small size of the outer last triangle of $\underline{\text{m. 3}}$ and that it is distinctly cut off from the posterior loop. In $\overline{\text{m. 1}}$ there is a broad crescentic loop as in Dr. Merriam's figure of *P. latimanus* but differing therefrom in its being completely cut off from the first outer triangle (loop) with which, in *latimanus*, it forms a trefoil. From all the four forms first described by Dr. Merriam it differs in having the second loop of $\overline{\text{m. 3}}$ almost completely divided into two sections by the exaggeration of the outer angle of this loop (see fig. of *latimanus*, pl. IV, N. A. F., No. 2) and the acuteness of the next entrant angle on the same side, forming a small outer median triangle whose inner angle is so nearly closed by the impinging enamel walls that the gap can only be seen by a glass. In this feature it resembles *P. orophilus* of Idaho, from which it differs in no essential dental characters. In color, however, the two are distinct and *oramontis* has an interparietal like *celatus*, which Dr. Merriam states to be very different from that of *orophilus*. There may be other cranial differences, but these are all that can be distinguished from the rather meagre description of *orophilus*. Only one specimen was sent me by Mr. Brooks.

TAMIAS QUADRIVITTATUS FELIX subsp. nov. Type, ad. ♀ ; col. of S. N. Rhoads, No. 2355. Col. by A. C. Brooks on the Mt. Baker Range (alt. 7000 ft.), Westminster Dist., B. Columbia, Aug. 13, 1895.

Description: Colors and color pattern as in *quadrivittatus* but much darker than that type. Darker also than *T. q. affinis* or *T. q. luteiventris*, which latter it most nearly resembles. From *luteiventris* of the same season it is distinguished by: (1) greater breadth and depth of

rusty orange suffusion of sides, cheeks and lower tail; (2) rusty brown of upper head, neck, shoulders and fore-back; (3) greater breadth and blackness of dark dorsal stripes and corresponding diminution and rustiness of white stripes; (4) absence of hoary appearance of whole upper surface seen in *luteiventris*.

Measurements: Total length, 245 mm.; tail vertebræ, 105; hind foot, 32.5. Skull; basilar length, 26.5; length of nasals, 10.5; interorbital constriction, 7.4; zygomatic expansion, 20; length of mandible, 11; greatest width of mandible, 20.

So far as I am able to examine specimens, this is the darkest representative of the *T. quadrivittatus* group. It is represented by a male and female, both adults and from the same locality. Their measurements show *felix* to be as large as, if not larger than, any of its conspecific allies.

The above newly described mammals formed part of a small collection recently made and forwarded to me by Mr. Allen C. Brooks. They demonstrate emphatically the wonderful variety which characterizes the Zoology of the mountain regions of the Pacific Slope, even in northern latitudes.—S. N. Rhoads.

Zoological News.—Mammalia—At the June meeting of the Linnean Society of N. S. Wales, Mr. Robert Brown read a paper on a new fossil Mammal allied to Hypsiprymnus, but resembling, in some points, the Plagiaulacidae. The remains, described under the names of *Burramys parvus*, are those of a small marsupial not larger than an ordinary mouse. The form is specially interesting in having but three true molars in each jaw, and a very large grooved premolar with serrate edge, very similar to that found in the Eocene genus Neoplagiaulax. Its affinities are dealt with at some length, and an endeavor made to trace its relationship phylogenetically. (Proceeds. Linn. Soc. N. S. W., 1895).

ENTOMOLOGY.[1]

Entomology at Springfield.—The most important entomological meeting at Springfield in connection with the A. A. A. S. was that of the Association of Economic Entomologists, August 27 and 28. The

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

President's address was delivered by Prof. J. B. Smith, after which the following papers were read:

J. M. Aldrich, Moscow, Idaho, Spraying without a pump; M. H. Beckwith, Newark, Del., The San José Scale in Delaware; F. H. Chittenden, Washington, D. C., Herbivorous Habits of certain Dermestidæ; T. D. A. Cockerell, Las Cruces, N. Mex., On the natural conditions which affect the distribution and abundance of Coccidæ; G. C. Davis, Agricultural College, Mich., Insects of the season in Michigan; C. H. Fernald, Amherst, Mass., The Gypsy Moth; C. P. Gillette, Fort Collins, Col., How shall we improve our Collections? F. L. Harvey, Orono, Me., Article on Smerinthus cerisyi; A. D. Hopkins, Morgantown, W. Va., (1) On the Study of Forest-tree Insects. (2) Some notes on observations of the season; L. O. Howard, Washington, D. C., Some shade-tree insects of Springfield and other New England towns; J. A. Lintner, Albany, New York, A paper; C. L. Marlatt, Washington, D. C., (1)The Elm-leaf Beetle in Washington. (2) Some notes on insecticides; J. B. Smith, New Brunswick, N. J., The uses of insect-lime; E. B. Southwick, New York City, (1) Economic entomological work in the parks of New York City. (2) A city entomologist and insecticides; F. M. Webster, Wooster, O., (1) Some interesting facts regarding the genus Diabrotica. (2) Importation and repression of destructive insects. (3) Insects of the year in Ohio; C. M. Weed, Durham, N. H., An important modification of the kerosene sprayer; H. E. Weed, Agricultural College, Miss. (1) Experiments with the kerosene knapsack sprayer. (2) Bisulphide of Carbon for Crayfish.

Prof. C. H. Fernald was elected President for the next year and Mr. C. L. Marlatt was re-elected Secretary, Resolutions indorsing the work of the Gypsy Moth Commission, and expressing regret at the discontinuance of *Insect Life* were passed.

In Section F. perhaps the most interesting entomological papers were those on the mouth parts of insects by Messrs. J. B. Smith and C. L. Marlatt.—C. M. W.

Pigments of Pieridæ.—Mr. F. G. Hopkins publishes[2] an abstract of a contribution to the study of excretory substances which function in ornament. The wing scales of the white Pieridæ are shown to contain uric acid, which substance bears the same relation to the scale as do the pigments in the colored Pieridæ, so that it practically functions as a white pigment. The yellow pigment found in the majority of the Pieridæ is a derivative of uric acid. The yellow pigment may be arti-

[2] Proc. Royal Soc. lvii, 1895, pp. 5 and 6.

ficially induced by heating uric acid with water in sealed tubes at high temperatures, and the identity of the natural and artificial products may be demonstrated by the similarity of their spectrum. Mr. Hopkins believes that this yellow substance, which may be called lepidotic acid, together with a closely allied red substance, will account for all the chemical pigmentation of the wing scales of the colored Pieridæ, though modifications may be produced by superadded optical effects. These uric acid derivatives, though universal on the Pieridæ, are apparently confined to this group among the Rhopalocera. This fact leads to the interesting observation that where a Pierid mimics an insect belonging to anothers family, the pigments in the two cases are chemically quite distinct. The fact that the scale pigments are really the normal excretory products of the animal utilized in ornament is emphasized by the observation that the yellow Pierids on emergence from the chrysalis are apt to void from the rectum a quantity of uric acid, colored by a yellow substance, which exactly resembles the pigment of the wing.—*Journal Royal Microscopical Society.*

Sense of Sight in Spiders.—Professor and Mrs. Peckham in continuing their studies of spiders have published[3] some extremely interesting observations upon the sense of sight. Concerning the range of vision the authors think their experiments "prove conclusively that Attidæ see their prey (which consists of small insects) when it is motionless, up to a distance of five inches; that they see insects in motion at much greater distances; and that they see each other distinctly up to at least twelve inches. The observations on blinded spiders and the numerous instances in which spiders which were close together, and yet out of sight of each other, showed that they were unconscious of each other's presence render any other explanation of their action unsatisfactory. Sight guides them, not smell."

The authors also experimented with the color sense of spiders, and reached the opinion "that all the experiments taken together strongly indicate that spiders have the power of distinguishing colors."

[3] Trans. Wisconsin Acad. X, pp. 231–261.

EMBRYOLOGY.[1]

Eggs of Nematodes.—Hans Spemann contributes to the May number of the Zoölogische Jahrbücher an elaborately illustrated account of the cleavage of the eggs of the Nematode *Strongylus paradoxus.* In general it is a confirmation of the results obtained by Boveri upon *Ascaris megalocephala.*

The egg divides into two equal cells, yet one contains all the yolk. Each divides into two and the four so produced become rearranged in a characteristic way.

Tho two cells from the one containing no yolk divide into right and left cells that increase to form the major part of the ectoderm at the period of gastrulation. One of the other two cells gives rise at its first division to entoderm and mesoderm, while the other produces four, of which three add themselves to the ectoderm and one remains as the originator of the sexual cells.

The author compares this cleavage to the divisions of an apical cell in a plant; the egg divides off an entoderm cell, a mes-entoderm cell and ectoderm cell, another ectoderm cell and finally remains as the origin of the sexual cells. The sexual cells may be thus readily traced backed to their ancestors amongst the blastomeres. They are separated as special cells in the fourth generation, starting from the undivided egg.

In this process of rapid separation of sexual and somatic cells, Boveri found in *Ascaris megalocephala* a peculiar nuclear differentiation. At the first cleavage the nucleus of one cell looses part of its chromatin and its chromosomes undergo a change of shape. The other cell undergoes a like change when divided, and so on till after five divisions all the cells but one have the modified nuclei. This cell with the unchanged nucleus becomes the the beginning of the sexual cells.

This remarkable nucleus differentiation has been sought for by Oscar Meyer[1] in the eggs of other nematodes namely, *Ascaris lumbricoides, A. rubicunda, A. labiata, A. mystax, A. perspicillum, Strongylus tetracanthus, S. paradoxus* and *Oxyuris vermicularis.* In the first three he finds essentially the same process as in the species studied by Boveri,

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Jenaische Zeitschrift., 29, May 15, 1895.

in the other cases the material was not suited to a decision on this point; the author thinks this differentiation between the nuclei of somatic and sexual cells may well be common to all the Ascaridæ.

A second subject taken up by Oscar Meyer in this paper is the origin of the centrosomes in the eggs of *Strongylus tetracanthus.* By the methods employed no centrosome could be found near the female pronucleus. The sperm-head is, on the other hand, accompanied by a very marked system of radiations surrounding an evident centrosome. As the male pronucleus approaches the female pronucleus two systems of radiations and two centrosomes are formed by the division of the single centrosome that accompanied the male pronucleus. When the pronuclei are united these two centrosomes become the centrosomes of the first cleavage spindle. In some abnormal cases the female pronucleus has a centrosome close to it, but this probably migrates from the male pronucleus. It thus seems that in this egg the centrosomes arise only in connection with the sperm.

The third problem taken up by the author is the question as to the nature of the difference between the two kinds of *Ascaris megalocephala.* Boveri found that some individuals have two chromosomes in each egg or sperm while others have but one. The former have been called the variety *bivalens,* the latter *univalens.*

Oscar Meyer examined 154 horses and found 19 infected with this parasite, 10 with the variety *univalens,* 8 with *bivalens* and 1 with both *univalens* and *bivalens.*

A careful examination of the external and internal anatomy and histology of both kinds failed to reveal any difference except in the sexual products. The eggs of *bivalens* measure 78–88 and those of *univalens* only 65–70 microns. The sperms are larger in *bivalens* and have a nucleus twice as large as in *univalens.*

The two kinds are very closely related and may, it seems, interbreed; at least the occurrence of eggs with three chromosomes as well as the finding of eggs of *univalens* penetrated by very large sperms points to such a conclusion. Copulation between the two kinds seems established by the discovery of worms with both sizes of sperms in the same egg-tube. A consideration of the numbers of apparent crosses so formed as compared with the possibilities that result from the presence of both kinds of sperm, leads to the conclusion that the crosses are not as frequent as they might be and that there may be some impediment to interbreeding. In other words the two kinds of Ascaris seem to be somewhat separated as physiological varieties in spite of their very close morphological relationship.

Cell Phenomena in the Triton Egg.—Following in the steps of Drüner Dr. H. Braus[3] of Jena, has made a careful study of cell division in the blastula stage of *Triton alpestris*. By special methods the achromatic spindles and polar radiations of cell division are brought out with great distinctness. In the spindle three kinds of fibers may be present; delicate fibers that aid in moving the chromosomes; fibers with a sheath, also pulling the chromosomes; and stout fibers that connect the two centrosomes and serve as a supporting system tending to resist the pressure exerted by the other fibers.

In the later blastula with several layers of cells just as in the gastrula and in the adult testis as made out by Drüner, the arrangement of the fibers in the spindle is such that the contracting ones that act upon the chromosomes form the mantle or outer part, while the pressure-resisting fibers form the axial part of the spindle.

In the early blastula, however, cell division is different; the spindle has its contracting fibers in the axial part and the resisting fibers in the outer part or mantle.

The author comes to the conclusion that the more primitive form of spindle is that found in the older stages of the ontogeny of the Triton.

In the same way the author thinks that the origin of the spindle within the nucleus in the early stages of the development of the Triton's egg is a cœnogenetic process, while its origin outside the nucleus, in the protoplasm of the cell, in the later stages and in the adult testis is really the more primitive method of spindle formation. In general the formation of a spindle within the nucleus is to be regarded as a recent innovation, not as the original method.

The very important question as to the reason for form in organisms, the laws of growth of organisms, receives a contribution from the author's decision that the position of the spindles in the Triton's blastulæ (the angle which the axis of the spindle forms in successive cell divisions) does not necessitate the arrangement of the cells to form parts and organs. The author shows that the position of the spindles would not give rise to sets of cells placed as they are in the two-layered blastulæ if there were no rearrangements of the cells after division. It is change in position of cells after their formation and not forces in the processes of cell division that leads to the growth of form.

In this Triton as many as nine sperms may enter one egg. These supernumerary sperms give rise, the author maintains, to certain extra nuclei recognizable even up to the blastula stage, so that the possibility of polyspermy having some lasting effect in the embryo receives some material basis.

[3] Jenaische Zeitschrift., May 15, 1895.

PSYCHOLOGY.[1]

Will and Reason in Animals.—One of the greatest needs of psychology is a suitable technical terminology. In most of the other sciences, the words used have a constant meaning, and one feels reasonably sure of understanding what the author wishes to say. In psychology there are few terms in use that are not ambiguous. The psychologist has adopted the phraseology of current speech, and too often, in endeavoring to free it of its ambiguity, he forgets that that very ambiguity bears witness to a complexity in the matter to be described which should not be arbitrarily simplified.

Especially is this found true when we endeavor to interpret the mental processes of the lower animals in terms of our own. We are ourselves "conscious," we "judge," "reason," "will," and we ask whether the lower forms of life are "conscious," whether they can "judge," "reason," "will." Such questions are vain unless we know precisely what mental processes we designate ourselves when we use the words. Yet, in most current discussions, it is apparently taken for granted that these words have a meaning; that the writer not only understands their meaning himself, but is assured that his readers will take them in the same sense. Even in the few cases where some serious attempt is made to exhibit the exact sense of the terms used, the writer proceeds upon the assumption that they have but one legitimate sense, and that that is the sense in which he uses them.

But, in fact, no words in common use have any precise meaning, and if this is true of all, it is doubly true of those which express the results of crude introspection, performed, for the most part, with practical ends in view only. Such are most of our psychological terms. While the processes which are designated by any one always have some inner bond of similarity, that bond may be, from the point of view of the scientific psychologist, of relatively slight importance in view of the variations to be found within it.

Let us, for example, examine some of the words used of conduct. The reflex and instinctive are commonly contrasted with the voluntary, and the impulsive are contrasted with the rational. The reflex, instinctive and impulsive are regarded as "lower types," since we share them with the lower animals; the voluntary and rational are the

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

"higher types," and much discussion has been expended on the question whether these also are found in the lower animals or not.

The word "voluntary" is used in three quite distinct senses, but all contain a common element. In its broadest sense, any act is voluntary which is performed at the instigation of a thought. In this sense it is contrasted with "forced" acts, such as those performed under physical compulsion with acts performed under physiological compulsion, such as reflexes, and with acts performed under what we may turn psychical compulsion, as the instinctive. Many impulses, especially those which hurry into action without allowing time for reflection, are felt to be only partly voluntary.

Now, at all times, one's actual thought content comprehends two groups of elements—those originated from within by association and habit and those originated from without by the suggestions of the environment. For the most part, the two blend into a harmonious whole and both find expression in conduct. But, occasionally, the two clash. If then, the environment wins the day and controls conduct, even though it be done through the intervention of thought, we are inclined to deny that the conduct is voluntary. If I surrender my purse at the the point of a pistol, I would not call the act voluntary, yet it is not involuntary in the same sense in which it would have been had the highwayman taken my hand and, by main force, thrust it into my pocket, closed it upon my purse, and withdrawn it.

So of other cases. Control by the idea train invariably implies, in some degree, the ability to withstand the solicitations of the environment. The adult feels most of those solicitations so slightly that he is scarcely aware of their presence. But it is different with a child. The child is ever "in mischief," because his ideation has not developed far enough to offset the tempting invitation "Eat me," "Break me," "Set me on fire," by foresight of the latter end. It is in those cases in which the inner control clearly gets the better of the outer that we feel the power of "will" to be manifested. This, then, is a second sense of the word voluntary.

It is only through sensation and idea, on the whole, that the environment can enter into a man's mind and control his acts. The reflexes are exceptions, but they are, for present purposes, negligible. And its entrance is accompanied by a sense of conflict, as if the kingdom were divided against itself. Now a similar feeling often arises in cases in which the influence of the environment as such is scarcely to be noticed. Every man's mind is a polity, and its habitual usages and active principles not infrequently conflict. Then we commonly invoke

our more remote past in some fashion at present incomprehensible, and there emerges that intangible, contentless power which, like the rudder on a ship, avails to hold us steadily to the course already planned, and makes our present and future symmetrical with our past. This is what we term "will" in the narrowest sense, and it is a comparatively rare phenomenon in the experience of most of us.

If we turn from such an analysis to the problem of volition in the lower animals, we find it much simplified. There can be no doubt that in the higher vertebrates, at least, the idea trains, however rudimentary, control conduct to some degree. Yet the part played by the reflexes and instincts is so much greater in them than in us, and ideation is so scanty that the sphere of the voluntary is much restricted. Cases of conflict, in which the ideal control overcomes the solicitations of sense, are probably of rare occurrence. I noted, a case not long ago, however, which seems here in point. A friend of mine had a very intelligent Irish terrier, who, having been bred to thrifty habits, knew better than to eat a scrap of food which had "cost money" until it had been "paid for." In the agonizing interval I have frequently seen him resort to what seemed to be expedients to overcome the temptation. He seemed to feel that the bit of meat exerted a specific attractive force upon his organized reflexes, that he could not help snapping at it if he allowed himself to look. He would dance about near it, carefully keeping his head twisted to one side, so as to keep the tempting morsel out of sight; sometimes, if the words "It's paid for, Patsy," were long delayed, he would run to the farthest corner of the room and stay there until he heard them. Then he would dart for the food so hastily that he sometimes fell in turning towards it, showing that he had had it in mind all along. It would seem that this dog, at least, was able to exert some direct ideational control over his reflexes, and was sufficiently intelligent to use suitable means to support that control when it was about to fail.

For the existence of the highest form of will in the lower animals, we have no direct evidence, and it is difficult to see how we ever can have any. In ourselves it is rare and elusive; it is known by introspection only, and can not be inferred in another by any external signs. The very fact that it is so unusual in us, and that it appears to be characteristic of the more highly evolved types of the human mind, raises a strong presumption against its existence in the lower minds.

The word "rational" has had a history very like that of "voluntary". In its simplest sense it designates conduct controlled by a more distant end; it is thus opposed to the impulsive conduct which seeks the pres-

ent end. It implies, therefore, the presence of complex associative processes. "Irrational" conduct is that which is inconsistent with some accepted end.

Foresight of the future and its accompanying apprehension of various possible ends always involves competition between those ends for the control of conduct. For various reasons into which I cannot now enter, the intrinsic attractiveness of most ends tends to vary from time to time, hence it is always possible that the end which survives competition and controls conduct soon loses its power, and the actor falls a prey to regret. This is especially likely to be the case when there has been little deliberation, or when the end adopted is near at hand. Thus the word "rational" has been transferred from conduct controlled by a distant rather than by a nearer end, to conduct controlled by an approved end, that is, by an end whose attractive power remains constant under all circumstances. In ordinary parlance, that conduct is "reasonable" which most men are inclined to, but a little reflection will convince any one that no conduct is reasonable for one, save that whose adoption does not involve the relinquishment of some end of greater or more permanent attractiveness.

In the first sense of the word "irrational," it is probable that some of the lower animals are more rational than others. But, on the whole, brutes are adapted to the coming environment rather by instinct than by reason, *i.e.*, rather by a series of psychical reflexes awakened by present stimuli than by conscious foresight of the future, giving rise to an analogous series of representative ideas. The sphere of ideational control is probably restricted to the immediate future. Hence it is scarcely possible that brutes should be rational in the second sense.

Some writers use "rational" as equivalent to "ethical," *i. e.*, of ends enforced by the community upon the individual. The usage rests upon the assumption that those principles which ultimately approve themselves to the individual are essentially in harmony with those enforced by the community. But it is not customary to enquire whether animals are rational in that sense, and I may ignore it for the present.

ANTHROPOLOGY.[1]

New Evidence of glacial Man in Ohio.—In a paper before a joint meeting of the Anthropological and Geological sections of the A. A. A. S. I presented detailed evidence of the discovery, in the glacial

[1] The department is edited by Henry C. Mercer, University of Penna, Phila.

terrace on the Ohio River at Brilliant near Steubenville, Ohio, of a chert implement one inch and three-quarters long and three-quarters of an inch wide in its widest part, making the third instance in which glacial man is proved by satisfactory specific evidence to have been in Ohio. The discovery was made in the summer of 1893 by Mr. Sam Huston, the county surveyor of Jefferson County. Mr. Huston resides at Steubenville and is well known to many scientific collectors who have availed themselves of his services; while his familiarity with gravel deposits and with the indications of their being disturbed or undisturbed is unexcelled by any one in the country.

For a long time the railroad has been engaged in removing gravel from pits along the extensive glacial terrace below Brilliant Station, on the Cleveland and Pittsburg R. R., about seven miles south of Steubenville. While excavations were in progress two years ago, Mr. Huston was engaged in overseeing public work in the immediate vicinity. When operations were suspended for dinner, Mr. Huston went into the pit on one occasion, where his attention was attracted by the flat end of a chipped implement slightly projecting from the perpendicular face of the gravel which was being removed. The material at this immediate locality was well-washed sand with very few pebbles. The bedding and cross-bedding were very clearly displayed both above and below the implement, and it was perfectly evident that there had been no disturbance of the strata since their original deposition.

The situation in the face of the bank was such that Mr. Huston was barely able to reach it with his hand by standing upon the slight amount of talus that was at the bottom. The implement was about half way up to the top of the bank, making it about eight feet below the surface. Mr. Huston conducted me to the locality, so that the evidence was collected by me upon the spot. The bank was subsequently worked off about twenty feet farther and then abandoned, but according to Mr. Huston the stratification was essentially the same as is shown in fresh sections near by. The evidence is so specific that there is no chance to question it in detail, since every item was carefully noticed and has been clearly retained in Mr. Huston's memory.

The gravel terrace at this point is one of the most extensive in that portion of the Ohio River, and is part of a series of terraces traceable from Pittsburg down to Wheeling, and indeed throughout the whole length of the river as far as Louisville. There is no question among geologists as to its glacial age. It corresponds precisely, in the Ohio River valley, with those along the Delaware, in New Jersey, and the Tuscarawas and the Little Miami in Ohio, in which relics of glacial

man have, heretofore, been found. These terraces along the Ohio regularly alternate from one side to the other. At Beaver, Pa., the terrace is 125 feet above the river. The height, however, diminishes gradually as we get farther away from the glacial boundary and the supply of material contributed by streams coming from the glaciated area. The terrace at Brilliant rises sixty-eight feet above the river, and extends southward for a distance of two miles, being more than a quarter of a mile wide for a considerable portion of the way. The implement was found near the lower end of this section of the terrace, and about half way between Riddle's Run and Salt Run coming in from the west. To any one who inspects the locality it will be seen to be impossible to separate the gravel strata in which this implement was found from the glacial deposit which is here so plain and so characteristic of the region.

On being carefully examined by Professor Putnam he remarked that the implement was a knife of very early type, and that under the glass it was clearly seen to be coated with the patina which indicates that it is a relic of great antiquity, and has lain for a long time in some such conditions as that described by Mr. Huston. Professor Putnam regarded it as a very important discovery.

Mr. F. H. Cushing, Vice-President of the Anthropological Section said that we have in this case an implement concerning which there can be no doubt that it was completely finished and is not a "reject." It had been carefully chipped to an edge all round; and not only so, but it had been used and sharpened; and what was still more significant it had been sharpened by the older, and not by the later processes, the edge had been chipped in sharpening not by pressing against it with a bone but by blows with another stone. Mr. Cushing also remarked with Professor Putnam upon the antiquity of the type. While continuing in use through later times on account of its convenience, it is without doubt one of the earliest types of implement and everything about it agrees perfectly with the conditions of its alleged discovery.

George Frederick Wright.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The American Microscopical Society held its Eighteenth Annual Meeting at Ithaca, N. Y., Aug. 21–23, 1895. The following were the proceedings: Address of welcome, by the Hon. D. F. Van Vleet; response by the President of the Society, Professor S. H. Gage.

The following papers were read and discussed during the sessions: Some Notes on Alleged Meteoric Dust, Magnus Pflaum, Pittsburg, Pa.; Corky Outgrowth of Roots and their Connection with Respiration, H. Schrenk, Cambridge, Mass.; A Practical Method of Referring Units of Length to the Wave Length of Sodium Light, Professor Wm. A. Rogers, Waterville, Me.; Some Peculiarities in the Structure of the Mouth Parts and Ovipositor of *Cicada septendecim*, Professor J. D. Hyatt, New Rochelle, N. Y.; The Lateral Line Systems of Sense Organs in Amphibia, Dr. B. F. Kingsbury, Defiance, O.; The Chlorophyll Bodies of *Chara coronata*, Professor W. W. Rowlee, Ithaca, N. Y.; Secondary Thickenings of the Rootstalks of Spathyema, Mary A. Nichols, Ithaca, N. Y.; Comparison of the Fleischel, the Gower and the Specific Gravity Method of Determining the Percentage of Hæmoglobin in Blood for Clinical Purposes, F. C. Busch and A. T. Kerr, Jr., Buffalo, N. Y.; The History of the Sex-Cells from the time of Segregation to Sexual Differentation in *Cymtogaster*, Professor C. H. Eigenmann, Bloomington, Ind.; A Fourth Study of the Blood, Showing the Relation of the Colorless Corpuscle to the Strength of the Constitution, Dr. M. L. Holbrook, New York City; Two Cases of Intercellular Spaces in Vegetable Embryos, K. M. Wiegand, Ithaca, N. Y.; The Fruits of the Order Umbelliferæ, Dr. E. J. Durand, Ithaca, N. Y.; The Action of Strong Currents of Electricity upon Nervous Tissue; Dr. P. A. Fish, Ithaca, N. Y.; The Morphology of the Brain of the Soft-Shelled Turtle and the English Sparrow Compared, Susanna P. Gage, Ithaca, N. Y.; The Flagella of Motile Bacteria, Dr. V. A. Moore, Washington, D. C.; The Primitive Source of Food Supply in the Great Lakes; Some Experiments in Methods of Plankton Measurements, Professor Henry B. Ward, Lincoln, Neb.; The Fruits of the Order Compositæ, Professor W. W. Rowlee and K. M. Wiegand, Ithaca, N. Y.; The Spermatheca and Methods of Fertilization in some American Newts and Salamanders, Dr. B. F. Kingsbury, Defiance, O.; Cocaine in the Study of Pond-life; Paraffin and Collodion Embedding, Professor H. S. Conser, Sunbury, Pa.; Formalin as a Hardening Agent for Nerve Tissue, Dr. Wm. C. Krauss, Buffalo, N. Y.; The Use of Formalin in Neurology, Dr. P. A. Fish, Ithaca, N. Y.; The Lymphatics and the Lymph Circulation, with Demonstration of Specimens and Apparatus, Dr. Grant S. Hopkins, Ithaca, N. Y.; New Points in Photo-micrographs and Cameras, W. H. Walmsley, Chicago, Ill.; The Question of Correct Naming and Use of Micro-reagents, Miss V. A. Latham, M. D., Chicago, Ill.; A New Way of Marking Objectives, Dr. Wm. C. Krauss, Buffalo, N. Y.; Demonstration of Histological Prepar-

ations by the Projection Microscope, Drs. Krauss and Mallonee, Buffalo, N. Y.; Improvements in the Collodion Method, Professor S. H. Gage, Ithaca, N. Y.; The Syracuse Solid Watch-Glass; A Metal Centering Block; A New Method of Making Cells and of Mounting in Glycerine, Dr. A. C. Mercer, Syracuse, N. Y.

The afternoon of Wednesday was devoted to an inspection of the Library and other University buildings. Illustrations of methods of marking micrometers upon a ruling engine were shown at Franklin Hall (Physical Building).

In the evening, President Gage gave his address: The Processes of Life Revealed by the Microscope—a Plea for Physiological Histology.

Thursday afternoon and evening were spent in an excursion on Cayuga Lake.

Friday afternoon was the business meeting of the Society, and in the evening there was an exhibition of microscopical objects, especially designed to give people who have not had the opportunity of making extended study with a magnifying glass, the privilege of seeing for themselves some of the interesting and instructive revelations of the microscope.

The Society appropriated $25.00 in support of Dr. Field's Bibliographical Bureau, and voted to send their proceedings regularly to it.

The forty-fourth meeting of the American Association for the Advancement of Science met in Springfield, Mass., from August 28th to September 4th inclusive. The officers of the meeting were:

President, E. W. Morley, Cleveland, Ohio; Vice-Presidents, A. Mathematics and Astronomy, Edgar Frisby, Washington, D. C.; B. Physics, W. LeConte Stevens, Troy, N. Y.; C. Chemistry, William McMutrie, Brooklyn, N. Y.; D. Mechanical Science and Engineering, William Kent, Passaic, N. J.; E. Geology and Geography, Jed. Hotchkiss, Staunton, Va.; F. Zoölogy, Leland O. Howard, Washington, D. C.; G. Botany, J. C. Arthur, Lafayette, Ind.; H. Anthropology, F. H. Cushing, Washington, D. C.; I. Economic Science and Statistics, B. E. Fernow, Washington, D. C.; Permanent Secretary, F. W. Putnam, Cambridge, Mass; General Secretary, Jas. Lewis Howe, Lexington, Va.; Secretary of the Council, Charles R. Barnes, Madison, Wis.; Secretaries of the Sections, A. Mathematics and Astronomy, Asaph Hall, Jr., Ann Arbor, Mich.; B. Physics, E. Merritt, Ithaca, N. Y.; C. Chemistry, W. P. Mason, Troy, N. Y.; D. Mechanical Science and Engineering, H. S. Jacoby, Ithaca, N. Y.; E. Geology and Geography, J. Perrin

Smith, Palo Alto, Cal.; F. Zoölogy, C. W. Hargett, Syracuse, N. Y.; G. Botany, B. T. Galloway, Washington, D. C.; H. Anthropology, Stewart Culin, Philadelphia, Pa.; I. Economic Science and Statistics, W. R. Lazenby, Columbus, Ohio; Treasurer, R. S. Woodward, New York, N. Y.

The papers which were read in Sections E, F, G and H, which include the natural sciences as usually defined, were the following:

FRIDAY, AUG., 30TH. *Section E, Geology.* The Relations of Primary and Secondary Structures in Rocks, by C. R. Van Hise; The Archæan and Cambrian Rocks of the Green Mountain Range in Southern Massachusetts, by B. K. Emerson; Gotham's Cave, or Fractured Rocks in Northern Vermont, by C. H. Hitchcock; Recent Discovery of the Occurrence of Marine Cretaceous Strata on Long Island, by Arthur Hollick; Geological Canals between the Atlantic and Pacific Oceans, by J. W. Spencer; Geological Notes on the Isles of Shoals, by H. C. Hovey; Great Falls of the Mohawk at Cohoes, N. Y., by W. H. C. Pynchon; Subdivision of the Upper Silurian in Northeast Iowa, by Andrew G. Wilson; Supplementary Notes on the Metamorphic Series of the Shasta Region of California, by J. P. Smith; Recent Elevation of New England, by J. W. Spencer.

Section F. The Evolution of the Insect Mouthpiece, by J. B. Smith (Lantern Illustrations); The Mouthpiece of Insects with Special Reference to the Diptera and Hemiptera, by C. L. Marlatt; On the Olfactory Lobes, by Charles S. Minot; Notes on Fleas, Mosquitoes and the Horse-flies, by L. O. Howard; On the Visceral Anatomy of the Lacertilia, by E. D. Cope; Characters which are useful in raising larvae of Sphingidae, by George Dimmock.

Section G. A Leaf Rot of Cabbage, by H. L. Russell; The Southern Tomato Blight, by Erwin F. Smith; Observations on the Development of Uncinula spiralis, by B. T. Galloway; The effect of sudden changes of turgor and of temperature on Growth, by Rodney H. True; Recording Apparatus for the Study of Transpiration of Plants, by Albert F. Woods; Pressure, Normal Work and Surplus Energy in Growing Plants, by George M. Holferty; Notes on the Ninth Edition of the London Catalogue of British Plants, by N. L. Britton; Obolaria virginica L. A Morphological and Anatomical Study, by Theodore Holm; Botany of Yakutat Bay, Alaska, by Frederick V. Coville.

Section H. The Dynasty of the Arrow, by Frank Hamilton Cushing; The Origin of Playing Cards, by Stewart Culin; The Origin of Money in China, by Stewart Culin; Mustach Sticks of the Ainus, by Stewart Culin; Some Arabic Survivals in the Lauguage and Folk-

usage of the Rio Grande Valley, by John G. Bourke; The Sacred Pole of the Omaha Tribe, by Alice C. Fletcher; The mystery of the name Pamunkey, by William Wallace Tooker; A Vigil of the Gods, by Washington Matthews.

MONDAY, SEPT. 25TH. *Section E.* Views of the Ice Age as two epochs, the Glacial and Champlain, by Warren Upham; Glacial Phenomena between Lake Champlain and Lake George and the Hudson, by G. F. Wright; Whirpool of Niagara, by G. W. Holley; Distribution of Sharks in the Cretaceous, by C. R. Eastman; Terminology proposed for the description of Pelecypoda, by A. Hyatt; The Equatorial Counter Currents, by W. M. Davis; Address by Maj. Jed Hotchkiss, the Vice-President of Section E, at 2 o'clock.

Section F. Stemmiiulus as an Ordinal Type, by O. F. Cook; Characters which are useful in raising larvae of Sphingidae, by George Dimmock; The Affinities of the Pythonomorph Reptiles, by E. D. Cope; Temperature Variations of cattle observed during extended periods of time, with reference to the Tuberculosis Test, by Julius Nelson.

Sections F and G. Variation after Birth, by L. H. Bailey; Rejuvenation and Heredity, by Charles S. Minot; The Distinction between Animals and Plants, by J. C. Arthur; Fungous Gardens in the nests of an Ant (Atta tardigrada Buckl.) near Washington, by Walter T. Swingle; Poisoning by Broad-leaved Laurel, Kalmia latifolla, by Frederick V. Colville; The Physiology of Isopyum biternatrum L., by D. T. McDougal; The Transmission of Stimuli-effects in Mimosa pudica L., by D. T. McDougal; Personal Nomenclature in the Myxomycetes, by O. F. Cook; A New Californian Liverwort, by Douglas H. Campbell; The number of spare Mother Cells in the Sporangia of Ferns, by Willis L. Jepson; The Constancy of the Bacterial Flora of Sour Milk, by H. L. Bolley; The Watermelon Wilt and other Wilt Diseases due to Fusarium, by Erwin F. Smith.

Section H. The year of Pleiides of Prehistoric Starlore, by R. G. Haliburton; An Iroquois Condolence, by W. M. Beauchamp; Mental Measurement in Anthropology, by J. McKeen Cattell; Some Symbolic Carvings from the Ancient Mounds of Ohio, by F. W. Putnam and C. C. Willoughby; Account of the Discovery of a chipped chert implement in undisturbed Glacial Gravel near Steubenville, O., by F. G. Wright; Notes on the Bushmen of Transvaal, by George Leith; presented by F. W. Putnam; Village Life among the Cliff Dwellers, by Stephen D. Peet; An Ojibwa Transformation Tale, by Harlan I. Smith; Old Mohawk Words, by W. H. Beauchamp; The Different

Races described by early Discoverers and Explorers, by Stephen D. Peet; Root Fungus of Maize, by George Macloskie; Enantiomorphism in Plants, by George Macloskie.

TUESDAY, SEPT. 3RD. *Section E.* Interesting Features in the Surface Geology of the Genesee Region, illustrated with lantern slides, by H. L. Fairchild; Japan, Gardner G. Hubbard; Great Falls of the Mohawk at Cohoes, N. Y.; illustrated with lantern slides, by W. H. C. Pynchon. In the afternoon the Section met with Section H.

Section F. On the Girdling of Elm Twigs by the Larvæ of *Orgygia leucostigma*, and its Results, by J. A. Lintner; Notes upon the Eupaguridæ, by Charles W. Hargitt; On a Revision of the North American Craspedosomatidæ, by O. F. Cook; A New Character in the Colobognatha, with Drawings of Siphonotus, by O. F. Cook; A New Wheel for Color Mixing in Tests for Color Vision, by J. H. Pillsbury; Some Further Results of Investigation of Areas of Color Vision in the Human Retina, by J. H. Pillsbury; A Study of Panorpa and Bittacus, by E. P. Felt.

WEDNESDAY, SEPT. 4TH. *Section H.* A Study in Anthropo-geography as a Branch of Sociological Investigation, by William Z. Ripley; The Algonquian Appellatives of the Siouan Tribes of Virginia, by W. M. Wallace Tooker; Indian Songs and Music, by Alice C. Fletcher; The Spider Goddess and the Demon Snare, by F. H. Cushing; The Influence of Prehistoric Pigmy Races on Early Calendars and Cults, with Notes on Dwarf Survivals by R. G. Haliburton; Account of the Discovery of a Chipped Chert Implement in Undisturbed Glacial Gravel near Steubenville, Ohio, by G. F. Wright; Palæothic Culture, its Characteristic Variations and Tokens, by Stephen D. Peet; A Melange of Micmac Notes, by Stansbury Hager; Grammatic Form and the Verb Concept in Iroquoian Speech, by J. W. B. Hewitt; Anthropometrical, Psychoneural and Hypnotic Measurements, by Arthur Mac Donald; The Education of Blind-deaf Mutes, by John Dutton Wright; A Study in Child Life, by L. O. Talbot; The Indians of Southern California, by Franz Boas; The Cosmogonic Gods of the Iroquois, by J. W. B. Hewitt; Word Formation in the Kootenay Language, by Alex. F. Chamberlain; Kootenay Indian Personal Names, by Alex. F. Chamberlain.

The following officers were elected for the coming year:

President—Edward D. Cope, of Philadelphia; *Vice-Presidents*—A—Mathematics and Astronomy, William E. Story, of Worcester; B—Physics, Carl Leo Mees, of Terre Haute, Ind.; C—Chemistry, W. A. Noyes, of Terre Haute, Ind.; D—Mechanical Science and Engineering, Frank O. Marvin, of Lawrence, Kansas; E—Geology and Geography,

Benjamin K. Emerson, of Amherst; F—Zoology, Theodore N. Gill, of Washington, D. C.; G—Botany, N. L. Britton, of New York City; H—Anthropology, Alice C. Fletcher, of Washington, D. C.; I—Social Science, William R. Lazenby, of Columbus, Ohio; *General Secretary*—Charles R. Barnes, of Madison, Wis.; *Secretary of the Council*—Asaph Hall, Jr., of Ann Arbor, Mich.; *Secretaries of the Sections*—A—Mathematics and Astronomy, Edwin B. Frost, of Hanover, N. H.; B—Physics, Frank P. Whitman, of Cleveland, Ohio; C—Chemistry, Frank P. Venable, of Chapel Hill, N. C.; D—Mechanical Science and Engineering, John Galbraith, of Toronto, Can.; E—Geology and Geography, A. C. Gill, of Ithaca, N. Y.; F—Zoology, D. S. Kellicott, of Columbus, Ohio; G—Botany, George F. Atkinson, of Ithaca, N. Y.; H—Anthropology, John G. Bourke, United States Army; I—Social Science, R. T. Colburn, of Elizabeth, N. J.; *Treasurer*—R. S. Woodward, of New York, N. Y.

The Annual Report of Secretary Putnam showed that 367 members have been in attendance, all parts of the country being well represented. From Springfied there were 15 and from the rest of Massachusetts 56. The other leading States were as follows: New York 90, District of Columbia 39, Pennsylvania 29, Ohio 18, Connecticut 14, Indiana 12. There were 185 new members elected and 58 made fellows. Four have died during the year. There have been three public lectures and 207 papers, divided as follows among the sections: A 16, B 34, C 42 D 6, E 17, F 16, G 28, H 33, I 13.

SCIENTIFIC NEWS.

Dr. Charles Valentine Riley curator of the department of Entomology in the U. S. National Museum died Sept. 15th in consequence of being thrown from a bicycle on the previous day.

The eminent scientist was born in London in 1843 and he attended schools in France and Germany. For six years he studied on the Continent of Europe. Two passions characterized his boyhood—one for collecting insects, the other for drawing and painting.

At the age of 17 he sailed for New York, where, after a seven weeks' voyage, he arrived with little means. He went West and settled upon a farm in Illinois. Here he remained for four years, and acquired an experience of practical agriculture. About the time of his majority he commenced journalistic work in Chicago, where, in connection with his work on the paper, he gave special attention to botany and entomology. In 1868 he accepted the office of State entomologist of Missouri. In the Spring of 1878 he was tendered the position of entomologist to the

Department of Agriculture, which he accepted, but shortly afterward relinquished, retaining, however, his position at the head of the Entomological Commission, and continuing his work in the service of the Government. In 1881 the Division of Entomology in the Department of Agriculture was formed, and Professor Riley was placed at its head —a position which he continued to occupy until last year, when, on account of impaired health, he tendered his resignation.

Professor Riley has given to the National Museum at Washington his private collection of American insects, containing more than 20,000 species, and represented by 115,000 pinned specimens, and much additional material unpinned and in alcohol. In 1889 he received the insignia of Knight of the Legion of Honor. At this time the French Minister of Agriculture wrote him a personal letter acknowledging the distinguished and valuable services which he had rendered to French agriculture.

Dr. Riley was a man of great energy as well as persistence of character. In his personality he was of full medium height and of graceful figure; and his face would have adorned a gallery devoted to poets or the heroes of sentimental fiction. He was of attractive manners, and an amiable disputant. He had retired from the responsibilities of official position to devote himself to study, of which he apparently had many years before him. His sudden death is a blow to science, and a great loss to his friends.

Dr. Samuel Henshaw of the Boston Society of Natural History has been spending a few months in Europe.

Prof. F. L. Washburn of the zoological department of the Oregon Agricultural College has accepted a position in the Oregon State University.

Professor F. Wm. Rane has resigned from the chair of agriculture and horticulture at the University of West Virginia to accept a similar position in the New Hampshire College of Agriculture and Mechanic Arts.

Prof. G. E. Morrow has accepted the presidency of the Oklahoma Agricultural and Mechanical College at Stillwater.

Prof. Edwin W. Doran has accepted the presidency of Ozark College at Greenfield, Missouri.

Prof. H. J. Waters of Pennsylvania State College has been elected Director of Missouri Experiment Station. Prof. F. B. Mumford of Michigan has been appointed Professor of Agriculture in the Missouri State University.

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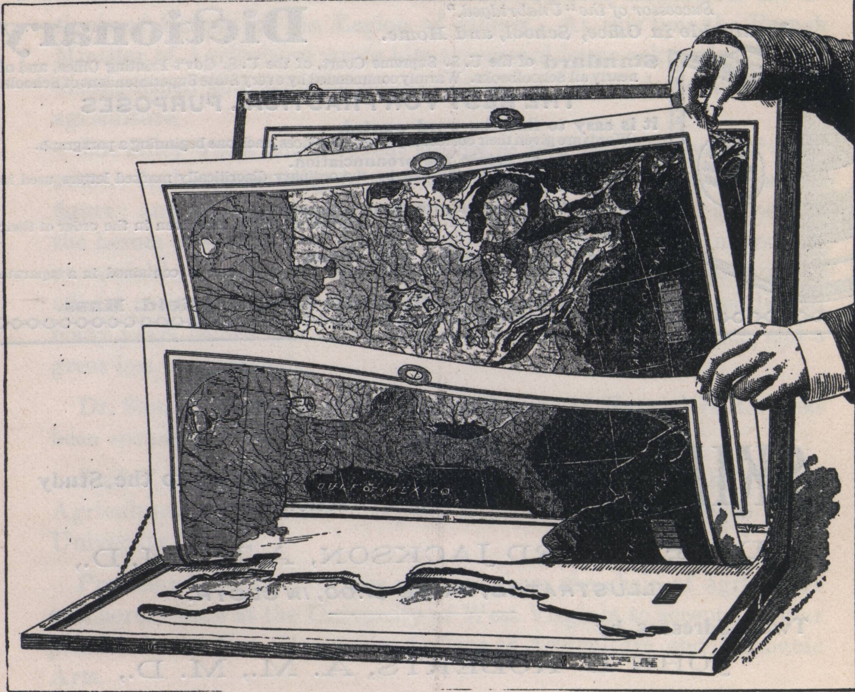

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